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[F]AULT-RUPTURE HAZARD ZONES IN CALIFORNIA

Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones[1] Maps

[1]Name changed from Special Studies Zones January 1, 1994

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FAULT-RUPTURE HAZARD ZONES IN CALIFORNIA

Alquist-Priolo Earthquake Fault Zoning Act
with Index to Earthquake Fault Zones Maps

REVISED 1994

by

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PREFACE

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act is to regulate development near active faults so as to mitigate the hazard of surface fault-rupture.

The report summarizes the various responsibilities under the Act and details the actions taken by the State Geologist and his staff to implement the Act.

This is the ninth revision of Special Publication 42, which was first issued in December 1973 as an "Index to Maps of Special Studies Zones." A text was added in 1975 and subsequent revisions were made in 1976, 1977, 1980, 1985, 1988, 1990, and 1992. The latest edition has been updated to reflect changes in the index map, the Division's Fault Evaluation and Zoning Program, and amendments to the Act.

On January 1, 1994, the name of the Alquist-Priolo Special Studies Zones Act was changed to the Alquist-Priolo Earthquake Fault Zoning Act, and the name Special Studies Zones was changed to Earthquake Fault Zones as a result of a July 25, 1993 amendment. A notice announcing these name changes has been sent to appropriate local and state agencies to facilitate assimilation of these changes. Other recent amendments are included in the revised Alquist-Priolo Act in Appendix A.

Information on new and revised Earthquake Fault Zones Maps will be provided as supplements until the next revision of this report.

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By

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INTRODUCTION

The Alquist-Priolo Earthquake Fault Zoning Act was signed into law December 22, 1972, and went into effect March 7, 1973. The Act, codified in the Public Resources Code as Division 2, Chapter 7.5, has been amended ten times. A complete text of the Act is provided in Appendix A. The purpose of this Act is to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture (Section 2621.5).

This law initially was designated as the Alquist-Priolo Geologic Hazard Zones Act. The act was renamed the Alquist-Priolo Special Studies Zones Act effective May 4, 1975 and the Alquist-Priolo Earthquake Fault Zoning Act effective January 1, 1994. The original designation "Special Studies Zones" was changed to "Earthquake Fault Zones" when the Act was last renamed.

Under the Act, the State Geologist (Chief of the Division of Mines and Geology) is required to delineate "earthquake fault zones" (EFZs) along known active faults in California. Cities and counties affected by the zones must regulate certain development "projects" within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. The State Mining and Geology Board provides additional regulations (Policies and Criteria) to guide cities and counties in their implementation of the law (California Code of Regulations, Title 14, Div. 2) [1]. A summary of principal responsibilities and functions required by the Alquist-Priolo Act is given in Table 1. The Policies and Criteria are summarized in Table 2, and the complete text is provided in Appendix B.

This publication identifies and describes (1) actions taken by the State Geologist to delineate Earthquake Fault Zones, (2) policies used to make zoning decisions, and (3) Official Maps of Earthquake Fault Zones issued to date. A continuing program to evaluate faults for future zoning or zone revision also is summarized. Other aspects of the Alquist-Priolo Earthquake Fault Zoning Act and its implementation are discussed by Hart (1978 and 1986). The effectiveness of the AP Act and program was evaluated by Reitherman and Leeds (1990). The program is implementing many of the recommendations in that report.

Information presented here is based on various in-house documents and publications of this author and others of the Division (see Appendix E). The assistance of Perry Wong (compilation of faults on Figure 4 and proofing), Richard R. Moar (drafting), Dinah Maldonado and Joy Sullivan (layout and design), and other technical and clerical staff of the Division in revising this report is gratefully acknowledged.

[1] At the time this publication was revised, the Board had not yet revised the regulations to reflect the changes in the names of the act and zones.

Table 1. Summary of responsibilities and functions under the Alquist-Priolo Earthquake Fault Zoning Act (see Appendix A for full Text of Act).

State Mining and Geology Board

1. Formulates policies and criteria to guide cities and counties (Sec. 2621.5 and 2623). (See Appendix B.)
2. Serves as Appeals Board (Sec. 673).

State Geologist

1. Delineates Earthquake Fault Zones; compiles and issues maps to cities, counties, and state agencies (Sec. 2622).
   a. Preliminary Review Maps.
   b. Official Maps.
2. Reviews new data (Sec. 2622).
   a. Revises existing maps.
   b. Compiles new maps.
3. Approves requests for waivers initiated by cities and counties (Sec. 2623).

Cities and Counties

1. Must adopt zoning laws, ordinances, rules, and regulations; primary responsibility for implementing Act (Sec. 2621.5).
2. Must post notices of new Earthquake Fault Zones Maps (Sec. 2621.9 and 2622).
3. Regulates specified "projects" within Earthquake Fault Zones (Sec. 2623).
   a. Determines need for geologic reports prior to project development.
   b. Approves geologic reports prior to issuing development permits.
   c. May initiate waiver procedures. (See Appendix F.)

Other

1. *Seismic Safety Commission*–advises State Geologist and State Mining and Geology Board (Sec. 2630).
2. *State Agencies*–prohibited from siting structures for human occupancy across active fault traces (Sec. 2621.5).
3. *Disclosure*–prospective buyers of any real property located within an Earthquake Fault Zone must be notified of that fact (Sec. 2621.9).

Table 2. Summary of policies and criteria adopted by the State Mining and Geology Board and codified in California Code of Regulations (see Appendix B for full text).

Policies

1. Defines active fault (equals potential hazard) as a fault that has had surface displacement during Holocene time (last 11,000 years) (Sec. 3601).
2. Defines "structure for human occupancy" and other terms (Sec. 3601).

3. Provides opportunity for public to comment on Preliminary Review Maps of Earthquake Fault Zones[1] (Sec. 3602).
4. Provides for comments and recommendations to State Geologist regarding Preliminary Review Maps (Sec. 3602).

Specific Criteria for Lead Agencies (Sec. 3603)

1. No structure for human occupancy defined as a "project" is permitted on the trace of an active fault. Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by active branches of the fault.
2. Requires disclosure of Earthquake Fault Zones to the public.
3. Requires that buildings converted to structures for human occupancy comply with provisions of the Act.
4. Requires geologic reports directed at the problem of potential surface faulting for all projects defined by the Act.
5. Requires cities and counties to review geologic reports for adequacy.
6. Requires that geologic reports be submitted to the State Geologist for open-file.

PROGRAM FOR ZONING AND EVALUATING FAULTS

Requirements of the Act

Section 2622 of the Alquist-Priolo Earthquake Fault Zoning Act (Appendix A) requires the State Geologist to:

1. "Delineate...appropriately wide earthquake fault zones to encompass all potentially and recently active traces of the San Andreas, Calaveras, Hayward, and San Jacinto faults, and such other faults, or segments thereof, as the State Geologist determines to be sufficiently active and well-defined as to constitute a potential hazard to structures from surface faulting or fault creep."

2. Compile maps of Earthquake Fault Zones and submit such maps to affected cities, counties, and state agencies for their review and comment. Following appropriate reviews, the State Geologist must provide Official Maps to the affected cities, counties, and state agencies.

3. Continually review new geologic and seismic data to revise the Earthquake Fault Zones or delineate additional zones.

These requirements constitute the basis for the State Geologist's fault-zoning program and for many of the policies devised to implement the program.

Program for Zoning Faults

As required under the Act, the State Geologist initiated a program early in 1973 to delineate Earthquake Fault Zones to encompass potentially and recently active traces of the San Andreas, Calaveras, Hayward, and San Jacinto faults, and to compile and distribute maps of these zones. A project team was established within the Division to develop and conduct a program for delineation of the zones.

Initially, 175 maps of Earthquake Fault Zones were delineated for the four named faults. These zone maps, issued as Preliminary Review Maps, were distributed for review by local and state government agencies on December 31, 1973. Following prescribed 90-day review and revision periods, Official Maps were issued on July 1, 1974. At that time, the Earthquake Fault Zones became effective and the affected cities and counties were required to implement programs to regulate development within the mapped zones. A second set of Official Maps–81 maps of new zones and five maps of revised zones–was issued on January 1, 1976 to delineate new and revised zones. Additional Official Maps of new and revised zones were issued in succeeding years, as summarized in Table 3.

All of the Earthquake Fault Zones Maps issued prior to January 1, 1977 were based almost solely on the mapping of others. Later maps are based extensively on interpretations of the Fault Evaluation and Zoning Program staff.

Table 3. Official Maps of Earthquake Fault Zones issued 1974 through 1993.

DATE OF ISSUE	NEW MAPS	REVISED MAPS	WITHDRAWN MAPS
July 1, 1974	175	-	-
January 1, 1976	81	5	-
January 1, 1977	4	3	-
January 1, 1978	1	-	-
July 26, 1978	2	-	-
January 1, 1979	4	7	-
January 1, 1980	21	9	-
January 1, 1982	13	27	2
July 1, 1983	18	12	-
January 1, 1985	33	10	-
July 1, 1986	18	14	-
March 1, 1988	58	4	-
January 1, 1990	60	25	-
November 1, 1991	46	8	-
July 1, 1993	1	10	2
Totals	535	134	4

As of January 1, 1994, 535 Official Maps of Earthquake Fault Zones have been issued. Of these, 134 have been revised since their initial issue and four have been withdrawn. The maps are identified by quadrangle map name and the date of issue or revision on the Index to Maps of Earthquake Fault Zones (Figure 4).

The maps delineate regulatory zones for the faults generally identified in Figure 1. Additional faults will be zoned in the future, and some zones will be revised. Thirty-six counties and 94 cities are affected by the existing Earthquake Fault Zones. These jurisdictions are listed in Table 4.

Definitions, Policies, Rationale

For the State Geologist to carry out the mandate to establish regulatory zones, certain terms identified in Section 2622 of the Act had to be defined and policies had to be developed to provide a consistent and reasonable approach to zoning. After the zoning program was underway and the surface fault-rupture process was better understood, other terms were defined and some zoning policies were modified.

[1] At the time this publication was revised, the Board had not yet revised the regulations to reflect the changes in the names of the Act and zones.

*Table 4. Cities and counties affected by Earthquake Fault Zones as of January 1, 1994**

CITIES (94)			COUNTIES (36)	
American Canyon	Hollister	San Bruno	Alameda	Sonoma
Arcadia	Huntington Beach	San Diego	Alpine	Stanislaus
Arcata	Indio	San Fernando	Butte	Ventura
Bakersfield	Inglewood	San Jacinto	Contra Costa	Yolo
Banning	La Habra	San Jose	Fresno	
Barstow	La Habra Heights	San Juan Bautista	Humboldt	
Benicia	Lake Elsinore	San Leandro	Imperial	
Berkeley	Livermore	San Luis Obispo	Inyo	
Bishop	Loma Linda	San Marino	Kern	
Brea	Long Beach	San Pablo	Lake	
Carson	Los Angeles	San Ramon	Lassen	
Cathedral City	Mammoth Lakes	Santa Clarita	Los Angeles	
Coachella	Milpitas	Santa Rosa	Marin	
Colton	Monrovia	Seal Beach	Mendocino	
Compton	Moreno Valley	Signal Hill	Merced	
Concord	Morgan Hill	South Pasadena	Modoc	
Corona	Murrieta	South San Francisco	Mono	
Culver City	Oakland	Temecula	Monterey	
Daly City	Pacifica	Trinidad	Napa	
Danville	Palmdale	Twentynine Palms	Orange	
Desert Hot Springs	Palm Springs	Union City	Riverside	
Dublin	Palo Alto	Ventura (San Buenaventura)	San Benito	
El Cerrito	Pasadena	Walnut Creek	San Bernardino	
Fairfield	Pleasanton	Whittier	San Diego	
Fontana	Portola Valley	Willits	San Luis Obispo	
Fortuna	Rancho Cucamonga	Windsor	San Mateo	
Fremont	Redlands	Woodside	Santa Barbara	
Gardena	Rialto	Yorba Linda	Santa Clara	
Glendale	Richmond	Yucaipa	Santa Cruz	
Hayward	Ridgecrest	Yucca Valley	Shasta	
Hemet	Rosemead		Siskiyou	
Highland	San Bernardino		Solano	

*To inquire about local government policies and regulations or to consult (obtain) copies of specific Earthquake Fault Zones maps, address the Planning Director of each county or city. Some jurisdictions have replotted the EFZ boundaries on large-scale parcel maps.

Fault and Fault Zone

A *fault* is defined as a fracture or zone of closely associated fractures along which rocks on one side have been displaced with respect to those on the other side. Most faults are the result of repeated displacement that may have taken place suddenly and/or by slow creep. A fault is distinguished from those fractures or shears caused by landsliding or other gravity-induced surficial failures. A *fault zone* is a zone of related faults that commonly are braided and subparallel, but may be branching and divergent. A fault zone has significant width (with respect to the scale at which the fault is being considered, portrayed, or investigated), ranging from a few feet to several miles.

Fault Trace

A *fault trace* is the line formed by the intersection of a fault and the earth's surface. It is the representation of a fault as depicted on a map, including maps of the earthquake fault zones.

Active Fault

For the purposes of this Act, an *active fault* is defined by the State Mining and Geology Board as one which has "had surface displacement within Holocene time (about the last 11,000 years)" (see Appendix B, Section 3601). This definition does not, of course, mean that faults having no evidence for surface displacement within Holocene time are necessarily inactive. A fault may be presumed to be inactive based on satisfactory geologic evidence; however, the evidence necessary to prove inactivity sometimes is difficult to obtain and locally may not exist.

Potentially Active Fault

Because the Alquist-Priolo Act requires the State Geologist to establish Earthquake Fault Zones to encompass all "potentially and recently active" traces of the San Andreas, Calaveras, Hayward, and San Jacinto faults, additional definitions were needed (Section 2622). Initially, faults were defined as *potentially active*, and were zoned, if they showed evidence of surface displacement during Quaternary time (last 1.6 million years, Figure 2). Exceptions were made for certain Quaternary (i.e., Pleistocene) faults that were presumed to be inactive based on direct geologic evidence of inactivity during all of Holocene time or longer. The term "recently active" was not defined, as it was considered to be

MAP SYMBOL	NAME OF PRINCIPAL FAULT
B	*Brawley
BV	*Buena Vista
C	*Calaveras
CA	Calico
CH	*Cleveland Hill
CM	Cedar Mtn.
CU	Cucamonga
DS	Deep Springs
DV	Death Valley
E	Elsinore
FS	*Fort Sage
G	*Garlock
GR	*Greenville
GV	*Green Valley and Concord
H	*Hayward
HA	Hat Creek
HC	*Hilton Creek & related
HE	Helendale
HL	Honey Lake
HU	Hunting Creek
I	*Imperial
J	*Johnson Valley & related
KF	*Kern Front & related
L	Lenwood
LA	Los Alamos
LL	*Little Lake
LO	Los Osos
LS	Little Salmon
M	*Manix
MA	*Maacama
MC	McArthur
ME	Mesquite Lake
MR	Mad River
N	*Nunez
ND	Northern Death Valley
NF	North Frontal
NI	*Newport-Inglewood
O	Ortigalita
OV	*Owens Valley
P	Pleito & Wheeler Ridge
PI	Pisgah-Bullion
PM	Pinto Mountain
PV	Panamint Valley
R	Raymond Hill
RC	Rose Canyon
RH	Rodgers Creek-Healdsburg
RM	Red Mountain
SA	*San Andreas
SC	San Cayetano
SF	*San Fernando
SG	San Gregorio
SGA	San Gabriel
SH	*Superstition Hills
SJ	*San Jacinto
SN	Sierra Nevada (zone)
SS	San Simeon
SV	Surprise Valley
V	Ventura
W	Whittier
WM	*White Mts.
WW	*White Wolf

*Faults with historic surface rupture.

Faults zoned through January 1, 1994.

Approximate boundaries of work-plan regions and year studied.

Note: Other faults may be zoned in the future and existing zones may be revised when warranted by new fault data.

Figure 1. Principal active faults in California zoned under the Alquist-Priolo Earthquake Fault Zoning Act. Dashed lines and dates identify recently completed work-plan for 10 regions and when studied.

covered by the term "potentially active." Beginning in 1977, evidence of Quaternary surface displacement was no longer used as a criterion for zoning. However, the term "potentially active" continued to be used as a descriptive term on map explanations on EFZ maps until 1988.

Sufficiently Active and Well-defined

A major objective of the Division's continuing fault evaluation and zoning program is to evaluate the hundreds of remaining potentially active faults in California for zoning consideration. However, it became apparent as the program progressed that there are so many potentially active (i.e., Quaternary) faults in the State (Jennings, 1975) that it would be meaningless to zone all of them. In late 1975, the State Geologist made a policy decision to zone only those potentially active faults that have a relatively high potential for ground rupture. To facilitate this, the terms "sufficiently active" and "well-defined," from Section 2622 of the Act, were defined for application in zoning faults other than the four named in the Act. These two terms constitute the present criteria used by the State Geologist in determining if a given fault should be zoned under the Alquist-Priolo Act.

Sufficiently active. A fault is deemed sufficiently active if there is evidence of Holocene surface displacement along one or more of its segments or branches. Holocene surface displacement may be directly observable or inferred; it need not be present everywhere along a fault to qualify that fault for zoning.

Well-defined. A fault is considered well-defined if its trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The fault may be identified by direct observation or by indirect methods (e.g., geomorphic evidence; Appendix C). The critical consideration is that the fault, or some part of it, can be located in the field with sufficient precision and confidence to indicate that the required site-specific investigations would meet with some success.

Determining if a fault is sufficiently active and well-defined is a matter of judgment. However, these definitions provide standard, workable guidelines for establishing Earthquake Fault Zones under the Act.

The evaluation of faults for zoning purposes is done with the realization that not all active faults can be identified. Furthermore, certain faults considered to be active at depth, because of known seismic activity, are so poorly defined at the surface that zoning is impractical. Although the map explanation indicates that "potentially active" (i.e., Quaternary) faults are identified and zoned (with exceptions) on the Official Maps of Earthquake Fault Zones until 1988, this is basically true only for those maps issued July 1, 1974 and January 1, 1976. Even so, all of the principal faults zoned in 1974 and 1976 were active during Holocene time, if not historically. Beginning with the maps of January 1, 1977, all faults zoned meet the criteria of "sufficiently active and well-defined."

Delineating the Earthquake Fault Zones

Earthquake Fault Zones are delineated on U.S. Geological Survey topographic base maps at a scale of 1:24,000 (1 inch equals 2,000 feet). The zone boundaries are straight-line segments defined by turning points (Figure 3). Most of the turning points are intended to coincide with locatable features on the ground (e.g., bench marks, roads, streams). Neither the turning points nor the connecting zone boundaries have been surveyed to verify their mapped locations.

Locations of Earthquake Fault Zone boundaries are controlled by the position of fault traces shown on the Official Maps of Earthquake Fault Zones. With few exceptions, the faults shown on the 1974 and 1976 Earthquake Fault Zones maps were not field-checked during the compilation of these maps. However, nearly all faults zoned since January 1, 1977, have been field-checked to verify that they do meet the criteria of being sufficiently active and well-defined.

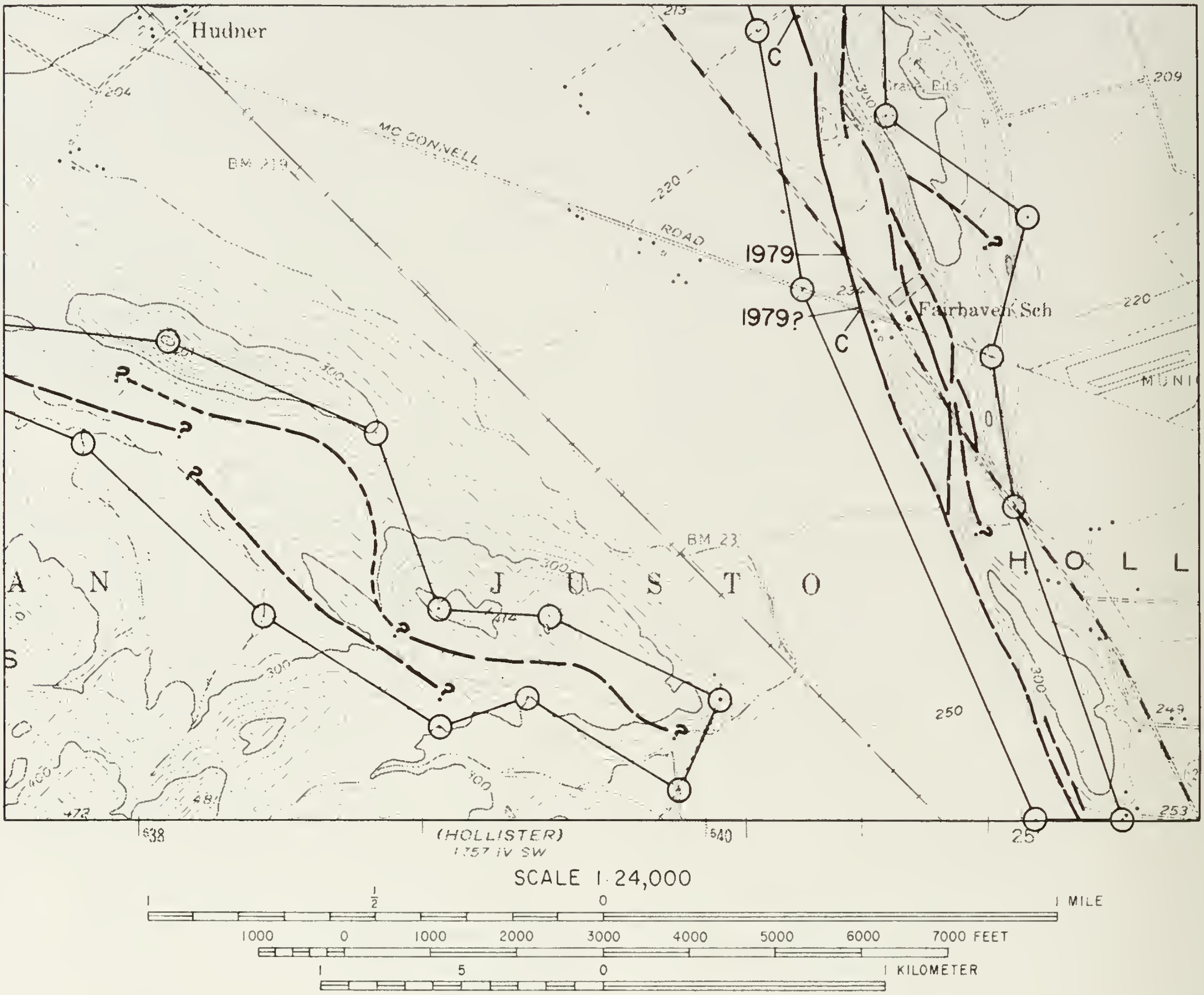
Zone boundaries on early maps were positioned about 660 feet (200 meters) away from the fault traces to accommodate imprecise locations of the faults and possible existence of active branches. The policy since 1977 is to position the EFZ boundary about 500 feet away from major active faults and

GEOLOGIC AGE			YEARS BEFORE PRESENT (estimated)
Era	Period	Epoch	
CENOZOIC	QUATERNARY	Historic	200
		Holocene	11,000
		Pleistocene	1,600,000
	TERTIARY	Pliocene	5,000,000
		pre-Pliocene	66,000,000
pre-CENOZOIC time			
Beginning of geologic time			4,600,000,000

Faults along which movement has occurred during this interval are defined as *active* by Policies and Criteria of the State Mining and Geology Board.

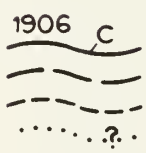
Faults defined as *potentially active* for the purpose of evaluation for possible zonation.

Figure 2. Geologic time scale.



MAP EXPLANATION

Active Faults



Faults considered to have been active during Holocene time and to have a relatively high potential for surface rupture; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Earthquake Fault Zone Boundaries


These are delineated as straight-line segments that connect encircled turning points so as to define earthquake fault zone segments.


Seaward projection of zone boundary.

Figure 3. Example of Earthquake Fault Zones map and explanation of map symbols.

about 200 to 300 feet away from well-defined, minor faults. Exceptions to this policy exist where faults are locally complex or where faults are not vertical.

Fault Evaluation and Zoning Program

The current Fault Evaluation and Zoning Program was initiated in early 1976 for the purpose of evaluating those "other faults" identified in the Act as "sufficiently active and well-defined" (see definition above) after it was recognized that effective future zoning could not rely solely on the limited fault data of others. Justification of this program is discussed in more detail in Special Publication 47 of the California Division of Mines and Geology (1976; also see Hart, 1978).

The program was originally scheduled over a 10-year period. The state was divided into 10 regions or work areas (Figure 1), with one region scheduled for evaluation each year. However, the work in some regions was extended due to heavy work loads. The fault evaluation work includes limited field mapping and the interpretation of aerial photographs, as well as the use of other geologists' work. A list of faults to be evaluated in a target region was prepared and priorities assigned. The list included potentially active faults not yet zoned, as well as previously zoned faults or fault-segments that warranted zone revisions (change or deletion). Faults also were evaluated in areas outside of scheduled regions, as the need arose (e.g., to map fault rupture immediately after an earthquake). The fault evaluation work was completed in early 1991. The work is summarized for each region in Open-File Reports (OFR) 77-8, 78-10, 79-10, 81-3, 83-10, 84-52, 86-3, 88-1, 89-16, and 91-9 (see Appendix E).

For each fault evaluated, a Fault Evaluation Report (FER) was prepared, summarizing data on the location, recency of activity, and sense and magnitude of displacement. Each FER contains recommendations for or against zoning. These in-house reports are filed at the Division's Bay Area Regional Office at 185 Berry Street, #3600, San Francisco 94107, where they are available for reference. Reference copies of the FERs are filed in the Division's Los Angeles office. An index to FERs prepared 1976 to April 1989 is available as OFR 90-9 (see Appendix E). This list and an index map identify the faults that have been evaluated. Microfiche copies of all FERs prepared through April 1989 are available in five regional sets as Open-File Reports OFR 90-10 to 90-14 (see Appendix E).

Under the AP Act (Sec. 2622), the State Geologist has an on-going responsibility to review "new geologic and seismic data" in order to revise the earthquake fault zones and to delineate new zones "when warranted by new information."

Beginning July 1991 a new five-year plan to evaluate faults was initiated and will be carried out in three phases-each about 20 months long. Efforts will be directed mainly at evaluating or re-evaluating faults in the more populated or developing areas of the state.

As a result of the fault evaluations made since 1976 , 279 new and 129 revised Earthquake Fault Zones Maps have been issued and four maps have been withdrawn (Table 3). The faults zoned are considered to meet the criteria of "sufficiently active and well-defined" (see Definitions above). Many other faults did not appear to meet the criteria and were not zoned. It is important to note that it is sometimes difficult to distinguish between slightly active faults and inactive ones, because the surface features formed as a result of minor, infrequent rupture are easily obliterated by geologic processes (erosion, sedimentation, mass wasting) or the activities of man. Even large scale fault-rupture can be obscured in complex geologic terranes or high-energy environments. Recent fault-rupture also is difficult to detect where it is distributed as numerous breaks or warps in broad zones of deformation. As a consequence of these problems, it is not possible to identify and zone all active faults in California. For the most part, rupture on faults not identified as active is expected to be minor.

Since zones were first established in 1974, there have been 22 earthquakes or earthquake sequences associated with surface faulting in various parts of California (Table 5). This is an average of 1.1 fault-rupture events per year. Most of the recent surface faulting has been relatively minor, either in terms of amount of displacement or length of surface rupture (Table 5). However, 30 cm (one foot) or more displacement occurred during six events in 20 years. Earlier records (incomplete) suggest that displacements of a meter (3 feet) or more occurs at least once every 15 to 20 years in California (Bonilla, 1970; Grantz and Bartow, 1977). Many of the recent coseismic events occurred on faults that were not yet zoned, and a few were on faults not considered to be potentially active or not even mapped. However, coseismic rupture also occurred on faults mostly or entirely within the Earthquake Fault Zones in eight of the 22 rupture events (Table 5). In addition, aseismic fault creep has occurred on many zoned faults in the last 20 years (see footnote, Table 5). Most fault creep is tectonically induced, although some is induced by man (mainly by fluid withdrawal).

In addition to evaluating and zoning faults, program staff also performs other functions necessary to the implementation of the APEFZ Act. Regulations (Section 3603, Appendix B) require that cities and counties file geologic reports for "project" sites in Earthquake Fault Zones with the State Geologist. By the end of 1993, 2,726 site-geologic reports had been filed for public reference (available at the Division's Bay Area Regional Office). Index maps and a directory of these reports have been prepared to make others aware of this resource (see OFRs 84-31, 89-5, and 90-15 in Appendix E). Appendix E is a complete list of publications and products of the Fault Evaluation and Zoning Program.

In order to improve the quality of site investigations and reports, guidelines were prepared in 1975 to assist others in evaluating faults. These guidelines have been slightly revised and appear as Appendix C.

General guidelines for reviewing geologic reports for adequacy, required by Section 3603 of the regulations, are provided in Appendix D.

If a city or county considers that a geologic investigation of a proposed "project" is unnecessary, it may request a waiver from the State Geologist (Section 2623, Appendix A). A waiver form detailing the procedures

Table 5. Surface faulting associated with earthquakes in California, 1974-June 1994. List excludes fault creep and faulting triggered by shaking or movement on a different fault[1]. See Bonilla (1970), Jennings (1985), and Grantz and Bartow (1977) for earlier faulting events.

Fault (County where located)	Year of rupture	Magnitude (Richter) of associated earthquake	Surface rupture[2] Maximum displacement (cm)	Total length[2] (km)	Main Sense of displacement[3]	Comments
1. Brawley (Imperial)	1975	4.7	20	10.4	N	Also ruptured in 1940 and 1979, fault creep in part.
2. Galway Lake (San Bernardino)	1975	5.3	1.5	6.8	RL	Fault previously unknown.
3. Cleveland Hill (Butte)	1975	5.7	5	5.7	N	Fault not previously known to be Holocene-active.
4. Stephens Pass (Siskiyou)	1978	4.3	30	2+	N	Fault previously unknown.
5. Homestead Valley (San Bernardino)	1979	5.2	8	3.3	RL	Also minor rupture on Johnson Valley fault.
6. *Calaveras (San Benito, Santa Clara)	1979	5.9	1	39(?)	RL	Minor, discontinuous rupture mostly in creep-active segment.
7. *Imperial } (Imperial)	1979	6.6	55	30	RL	Creep triggered on San Andreas and Superstition Hills faults;also ruptured in1940. Rico fault not previously known.
*Brawley } (Imperial)			15	13	N	
Rico } (Imperial)			10	1	N	
8. Greenville (Alameda)	1980	5.6	3	6.5	RL	Minor left-lateral slip also occurred on Las Positas fault.
9. Hilton Creek-Mammoth Lakes (Mono)	1980	6.0-6.5	30	20	N	Rupture on many minor faults, may relate to volcanic activity.
10. "Lompoc quarry" (Santa Barbara)	1981	2.5	25	0.6	R	Flexural slip on flank of syncline triggered by quarrying; do not plan to zone.
11. Little Lake (Kern)	1982	5.2	0+	10	RL/N	Fracture zones on monoclines.
12. "Coalinga Nose" (Fresno)	1983	6.7	5	.005	R	Secondary fault(?) associated with 43cm of anticlinal uplift; too minor to zone.
13. Nunez (Fresno)	1983	5.2-5.9	60	3.3	R	Aftershocks associated with event (12) above.
14. *Calaveras (Santa Clara)	1984	6.1	20(?)	1.2	RL	Questionable faulting; triggered afterslip in 15-km long creep-zone to south.
15. *Banning (Riverside)	1986	5.9	7	9	RL	Minor slip also triggered locally on Garnet Hill and Desert Hot Springs (?) faults as well as more distant faults.
16. *White Mountains (Mono, Inyo)	1986	6.4	11	13	RL/N	Also extensional cracks on faults in Volcanic Tableland in 40km x 12km area.
17. Elmore Ranch (Imperial)	1987	6.2	12	12	LL	Also lesser left-lateral rupture on nearby faults.
18. *Superstition Hills (Imperial)	1987	6.6	90	28	RL	Much of rupture occurred as afterslip; associated with event 17.
19. *San Andreas (Santa Cruz)	1989	7.1	2.5	1?	RL	Surface rupture possibly triggered slip; slip also triggered on nearby Calaveras and San Andreas faults outside of aftershock zone. Secondary faulting may have occurred with ridgetop spreading fissures.
20. *Johnson Valley, *Homestead Valley, *Emerson, *Camp Rock } (San Bernardino)	1992	7.3	460-600	85	RL	Most significant fault rupture since 1906; ruptures connected several separate faults; triggered slip also occurred on at least 10 other faults.
21. "Eureka Valley" (Inyo)	1993	6.1	2	5+	RL/N	Two zones of left-stepping fractures along pre-existing fault scarps; incompletely mapped; remote area, not zoned.
22. "Stevenson Ranch" (Los Angeles)	1994	6.7	19	0.6	R	Flexural slip faults on limb of fold near Newhall; related to blind thrust faulting. Minor slip also triggered on Mission Wells fault, which ruptured in 1971.

[1] Tectonic (aseismic) fault-creep and triggered slip have occurred along various segments of the San Andreas, Hayward, Calaveras, Concord, Imperial, Superstition Hills, Maacama, Garlock, and more than 10 other faults. Man-induced fault-creep has been reported on at least 12 other faults due to withdrawal of groundwater or oilfield fluids.

[2] Includes some afterslip. Rupture length measured from distal ends of rupture, which often is discontinuous.

[3] N = normal displacement; R = reverse displacement; RL = right-lateral displacement; LL = left-lateral displacement.

waiver requests have been processed by program staff.

Another important activity is to provide information on the APEFZ Act, the Division's Fault Evaluation and Zoning Program, and fault-rupture hazards to both the public and private sectors. Program staff responds to about 3,000 inquiries each year from geologists, planners, building officials, developers, realtors, financial institutions, and others.

Uses and Limitations of Earthquake Fault Zones Maps

The Earthquake Fault Zones are delineated to define those areas within which special geologic site studies are required prior to building structures for human occupancy. Traces of faults are shown on the maps mainly to justify the locations of zone boundaries. These fault traces are plotted as accurately as the sources of data permit; yet the plots are not sufficiently accurate to be used as the basis for building set-back requirements, and they should not be so used.

The fault information shown on the maps is not sufficient to meet the requirement for special geologic studies. Local governmental units must require the developer to have specific sites within the Earthquake Fault Zones evaluated to determine if a potential hazard from any fault, whether heretofore recognized or not, exists with regard to proposed structures and their occupants.

The surface fault-ruptures associated with historic earthquake and creep events are identified where known. However, no degree of relative potential for future surface displacement or degree of hazard is implied for the faults shown. Surface ruptures resulting from the secondary effects of seismic shaking (e.g., landsliding, differential settlement, liquefaction) are omitted from the map and do not serve as a basis for zoning.

Active faults may exist outside the Earthquake Fault Zones on any zone map. Therefore, fault investigations are recommended for all critical and important developments proposed outside the Earthquake Fault Zones.

INDEX TO MAPS OF EARTHQUAKE FAULT ZONES

The following pages (Figures 4A to 4J) indicate the names and locations of the Official Maps of Earthquake Fault Zones delineated by the California Division of Mines and Geology under the Alquist-Priolo Earthquake Fault Zoning Act (Appendix A). These index pages identify all Official Maps of Earthquake Fault Zones released by the State Geologist through 1993. The official maps are compiled on U.S. Geological Survey 7.5-minute topographic quadrangle maps at a scale of 1 inch equals 2,000 feet (Figure 3). Cities and counties affected by these maps are listed in Table 4.

Because Earthquake Fault Zones maps are issued every year or two to delineate revised and additional zones, users of these maps should check with the Division of Mines and Geology for up-to-date information on new and revised Earthquake Fault Zones maps. A change in zones also may affect different local governments. This index to Official Maps of Earthquake Fault Zones (Figures 4A to 4J) will be revised in future years as new maps are issued.

The Earthquake Fault Zones maps are available for purchase as indicated under Availability of Earthquake Fault Zones Maps. Also, they may be consulted at any office of the Division of Mines and Geology and at the planning departments of all cities and counties affected locally by Earthquake Fault Zones (Table 4).

Availability of Earthquake Fault Zones Maps

Reproducible masters, from which copies of local Earthquake Fault Zones maps (scale 1:24,000) can be made, have been provided to each of the cities and counties affected by the zones. Requests for copies of particular Earthquake Fault Zones maps of local areas should be directed to the Planning Director of the appropriate city or county. Refer to the index of Earthquake Fault Zones maps for the quadrangle names of the maps needed.

Arrangements also have been made with BPS Reprographic Services, San Francisco, to provide blue line copies of the Earthquake Fault Zones maps to those who cannot get them conveniently from the cities and counties.

BPS Reprographic Services
149 Second Street
San Francisco, CA 94105
Telephone: (415) 512-6550

Each map must be ordered by quadrangle name as shown on the index map. The cost of the maps is nominal; handling and C.O.D. charges are extra. These maps are not sold by the Division of Mines and Geology.

REFERENCES

(See Appendix E for Complete list of AP Products)

Bonilla,M.G.1970, Surface faulting and related effects in R.L. Wiegel, editor, Earthquake Engineering: Prentice-Hall, Inc., Englewood Cliffs, NJ, p. 47-74.

California Division of Mines and Geology, 1976, Active fault mapping and evaluation program —10-year program to implement Alquist-Priolo Special Studies Zones Act: California Division of Mines and Geology Special Publication 47, 42 p.

Grantz, A., and Bartow, A., 1977, Active faults of California: U.S. Geological Survey pamphlet, 15 p.

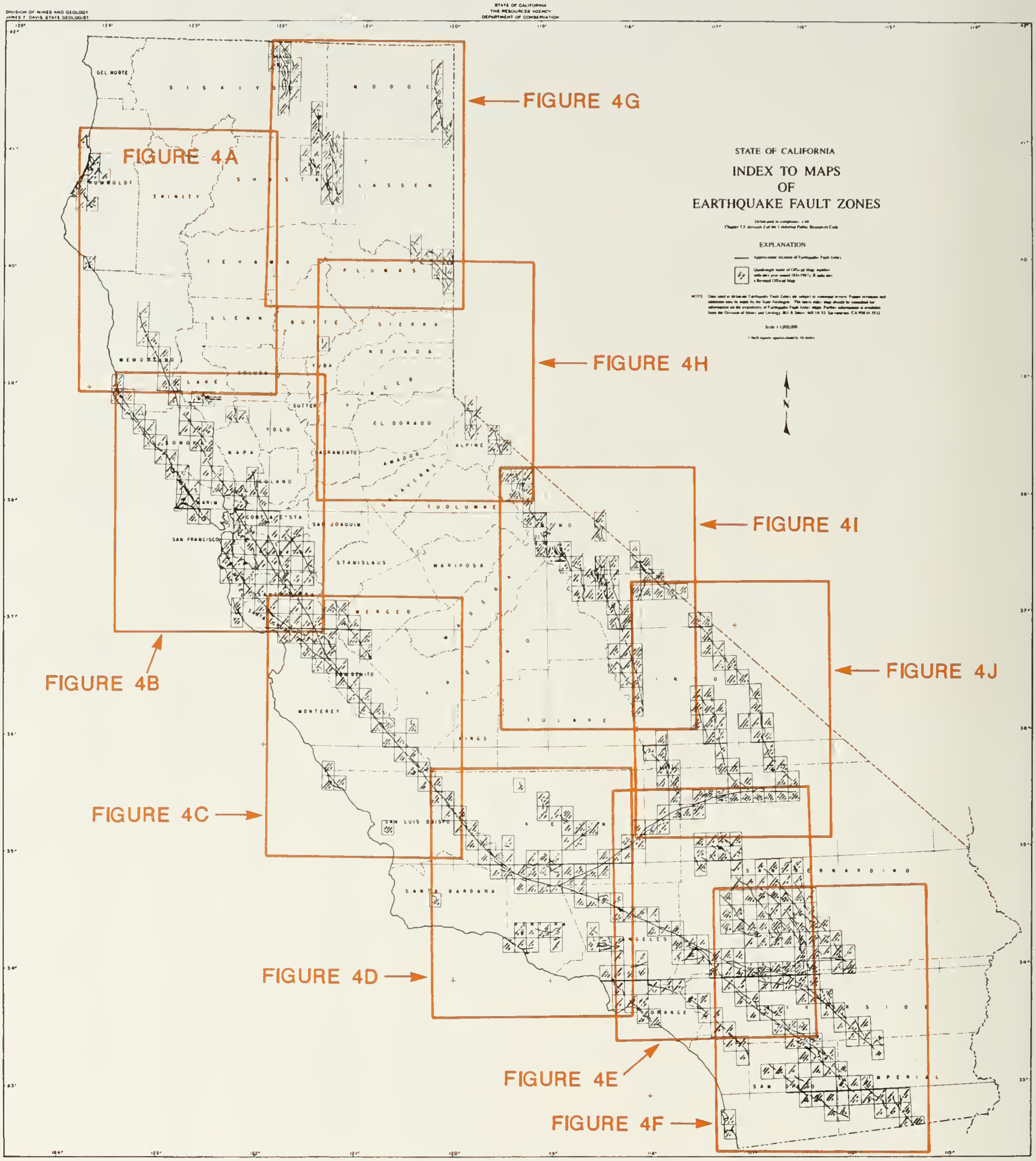
Hart, E.W., 1978, Zoning for the hazard of surface fault rupture in California: International Conference on Microzonation, 2nd, San Francisco, 1978, Proceedings, v. 2, p. 635-646.

Hart, E.W., 1986, Zoning for the hazard of surface faulting in California in Proceedings Conference XXXII--Workshop on future directions in evaluating earthquake hazards in southern California, Nov. 12-13, 1985: U.S. Geological Survey Open-file Report 86-401, p.74-83.

Jennings, C.W., 1975, Fault map of California with locations of volcanoes, thermal springs, and thermal wells: California Division of Mines and Geology Data Map No. 1.

Jennings, C.W.,1985, An explanatory text to accompany the 1:750,000 scale Fault and Geologic Maps of California: Division of Mines and Geology Bulletin 201, 197 p., 2 plates.

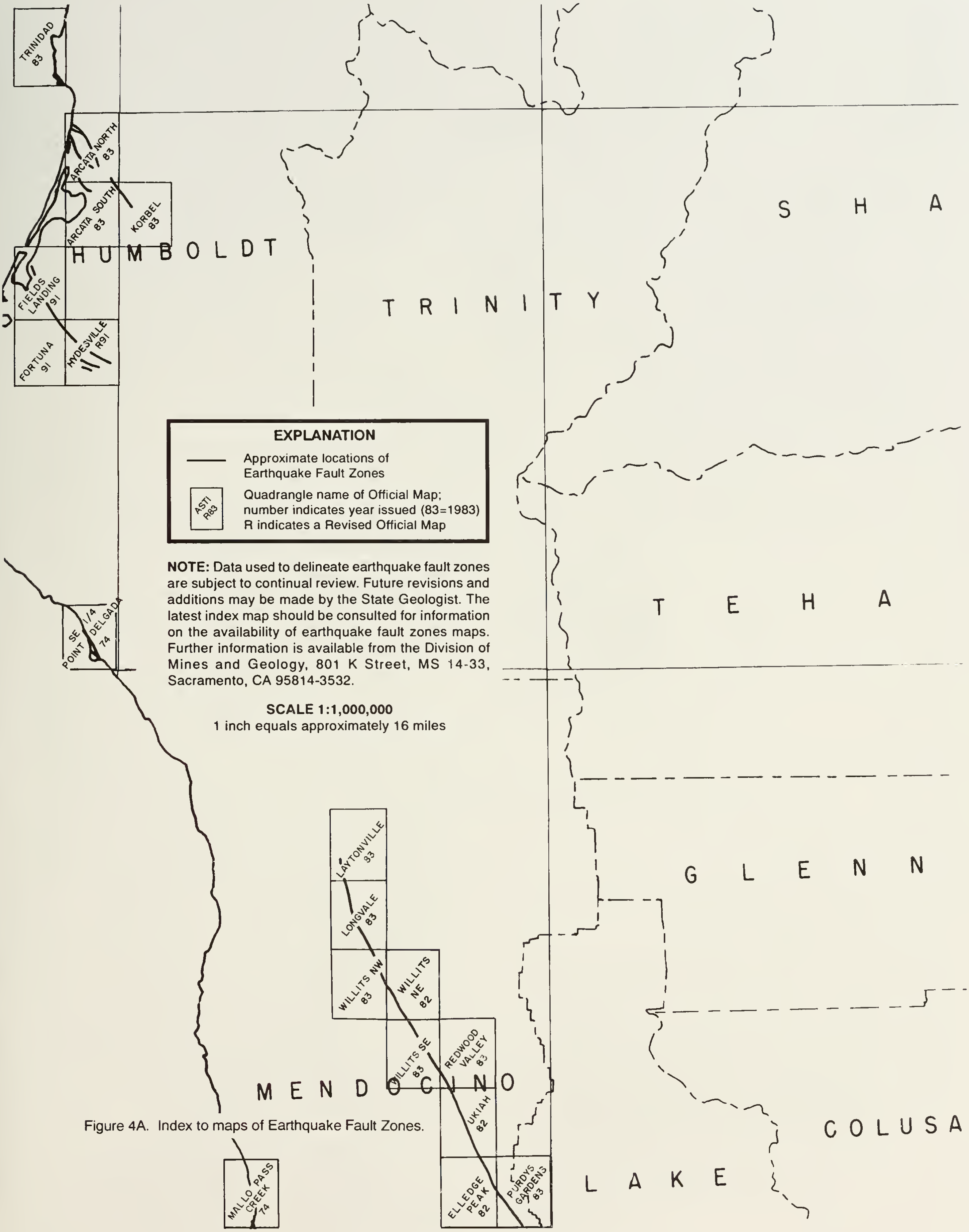
Reitherman, R., and Leeds, D.J.,1990, A study of the effectiveness of the Alquist-Priolo program: California Division of Mines and Geology Open-File Report 90-18, 131 p.



Data used to delineate Earthquake Fault Zones are subject to continual review. Future revisions and additions may be made by the State Geologist. Future supplements to this report should be consulted for information on the availability of Earthquake Fault Zones maps.

These Earthquake Fault Zones maps are delineated in compliance with Chapter 7.5, Division 2 of the California Public Resources Code.

Figure 4. Index to maps of Earthquake Fault Zones.



EXPLANATION

Approximate locations of Earthquake Fault Zones

Quadrangle name of Official Map; number indicates year issued (83=1983) R indicates a Revised Official Map

NOTE: Data used to delineate earthquake fault zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of earthquake fault zones maps. Further information is available from the Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3532.

SCALE 1:1,000,000
1 inch equals approximately 16 miles

Figure 4A. Index to maps of Earthquake Fault Zones.

EXPLANATION

Approximate locations of Earthquake Fault Zones

Quadrangle name of Official Map; number indicates year issued (83=1983) R indicates a Revised Official Map

NOTE: Data used to delineate earthquake fault zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of earthquake fault zones maps. Further information is available from the Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3532.

SCALE 1:1,000,000
1 inch equals approximately 16 miles

Figure 4B. Index to maps of Earthquake Fault Zones.

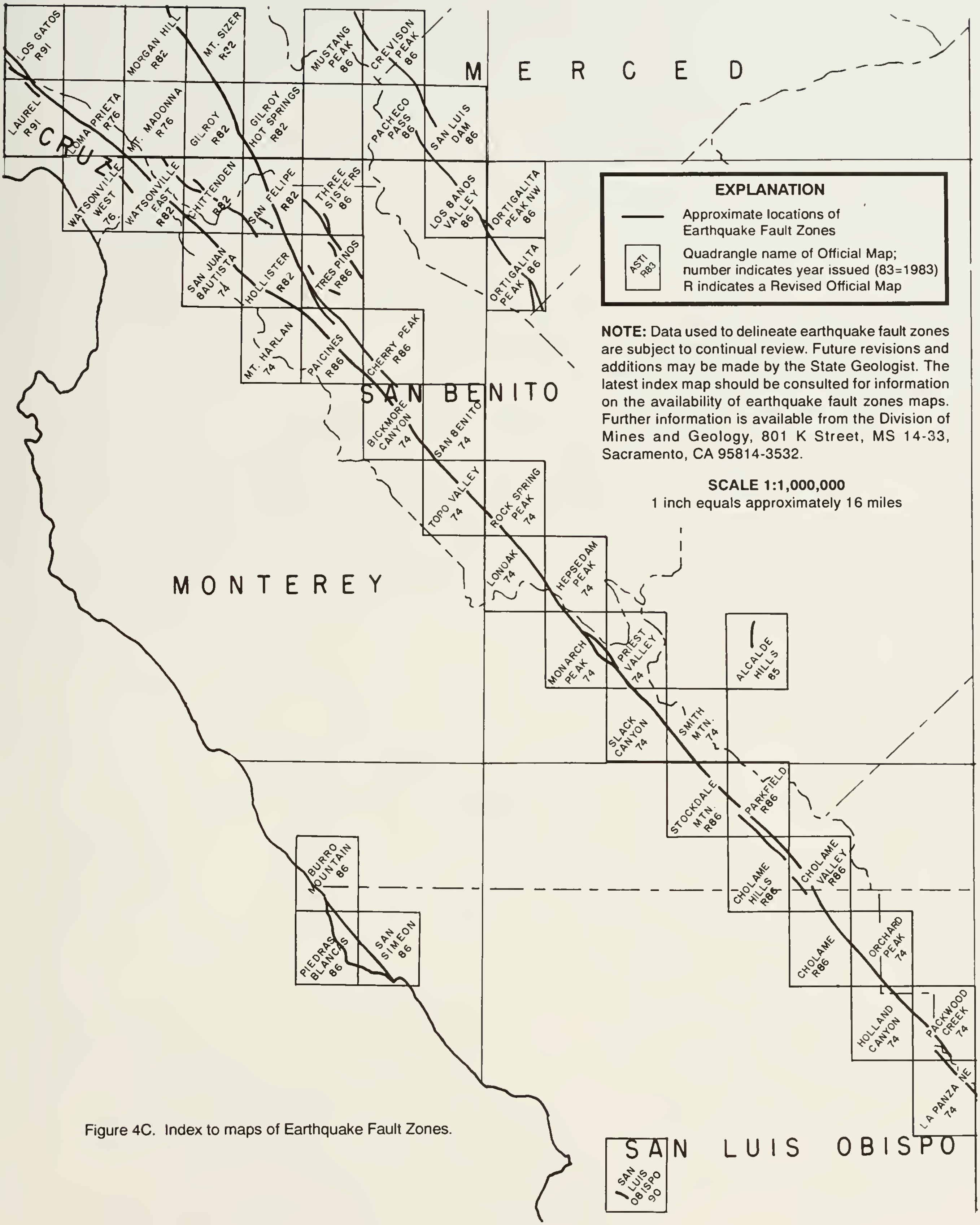
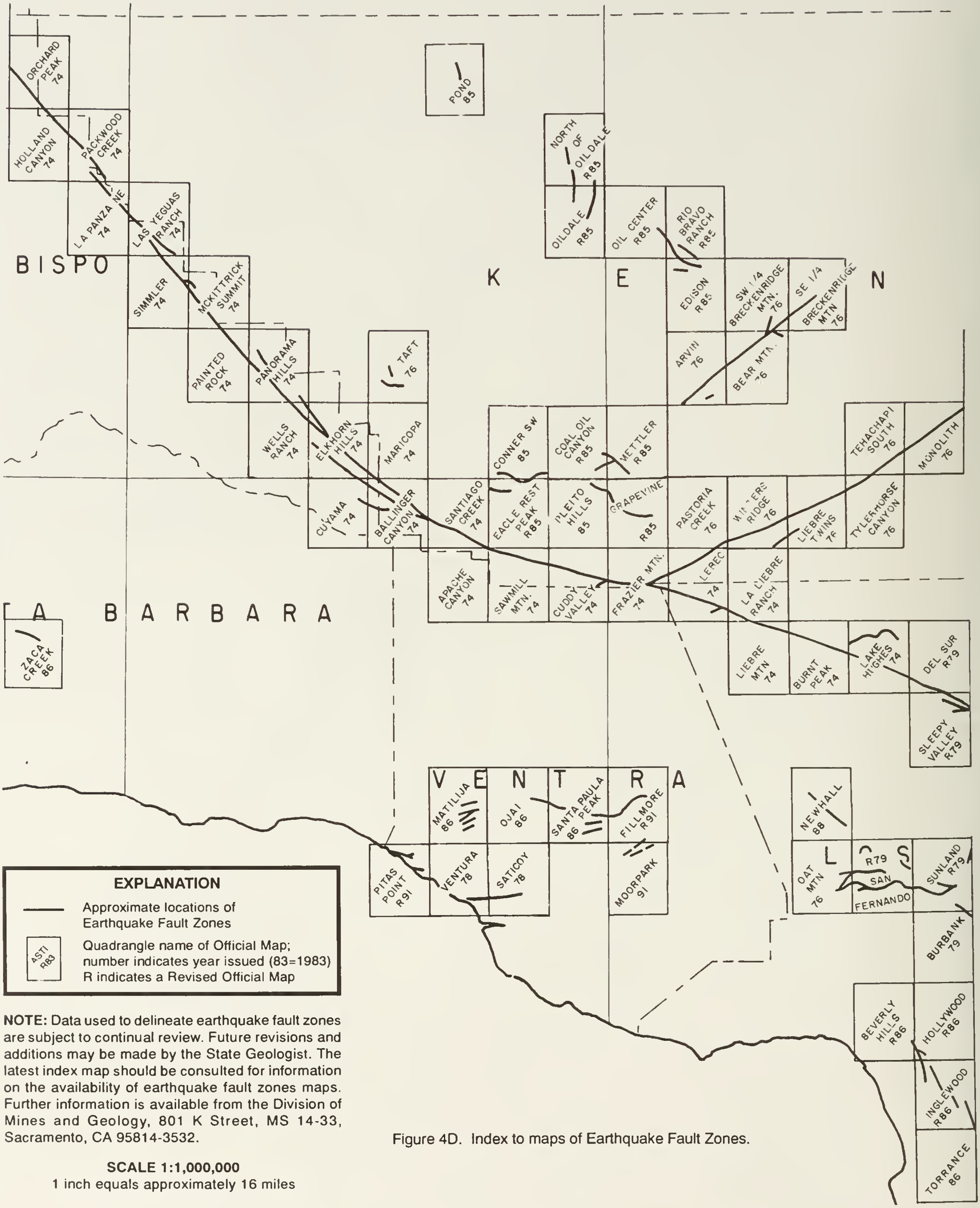


Figure 4C. Index to maps of Earthquake Fault Zones.



NOTE: Data used to delineate earthquake fault zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of earthquake fault zones maps. Further information is available from the Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3532.

SCALE 1:1,000,000
1 inch equals approximately 16 miles

Figure 4D. Index to maps of Earthquake Fault Zones.

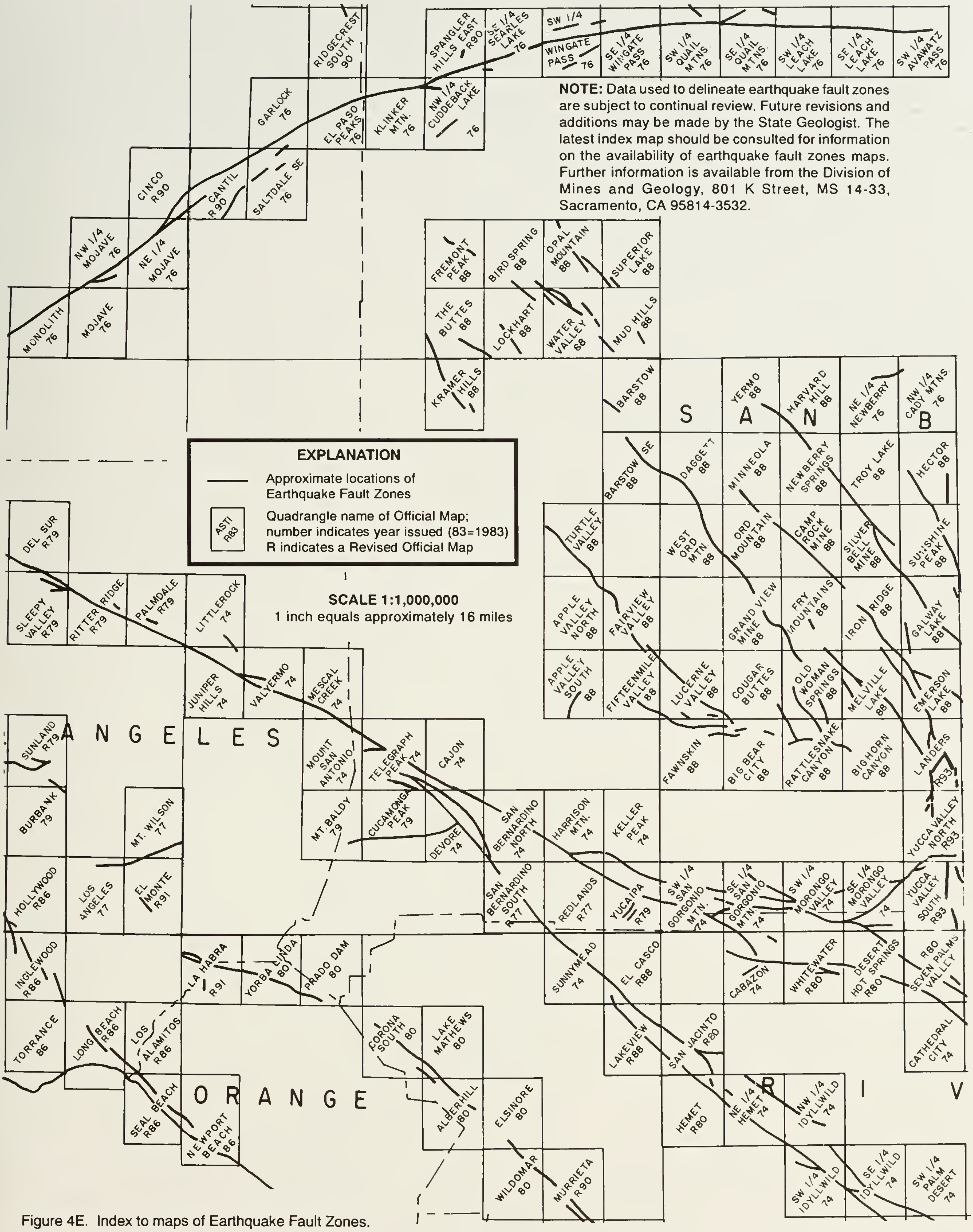


Figure 4E. Index to maps of Earthquake Fault Zones.

NOTE: Data used to delineate earthquake fault zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of earthquake fault zones maps. Further information is available from the Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3532.

SCALE 1:1,000,000
1 inch equals approximately 16 miles

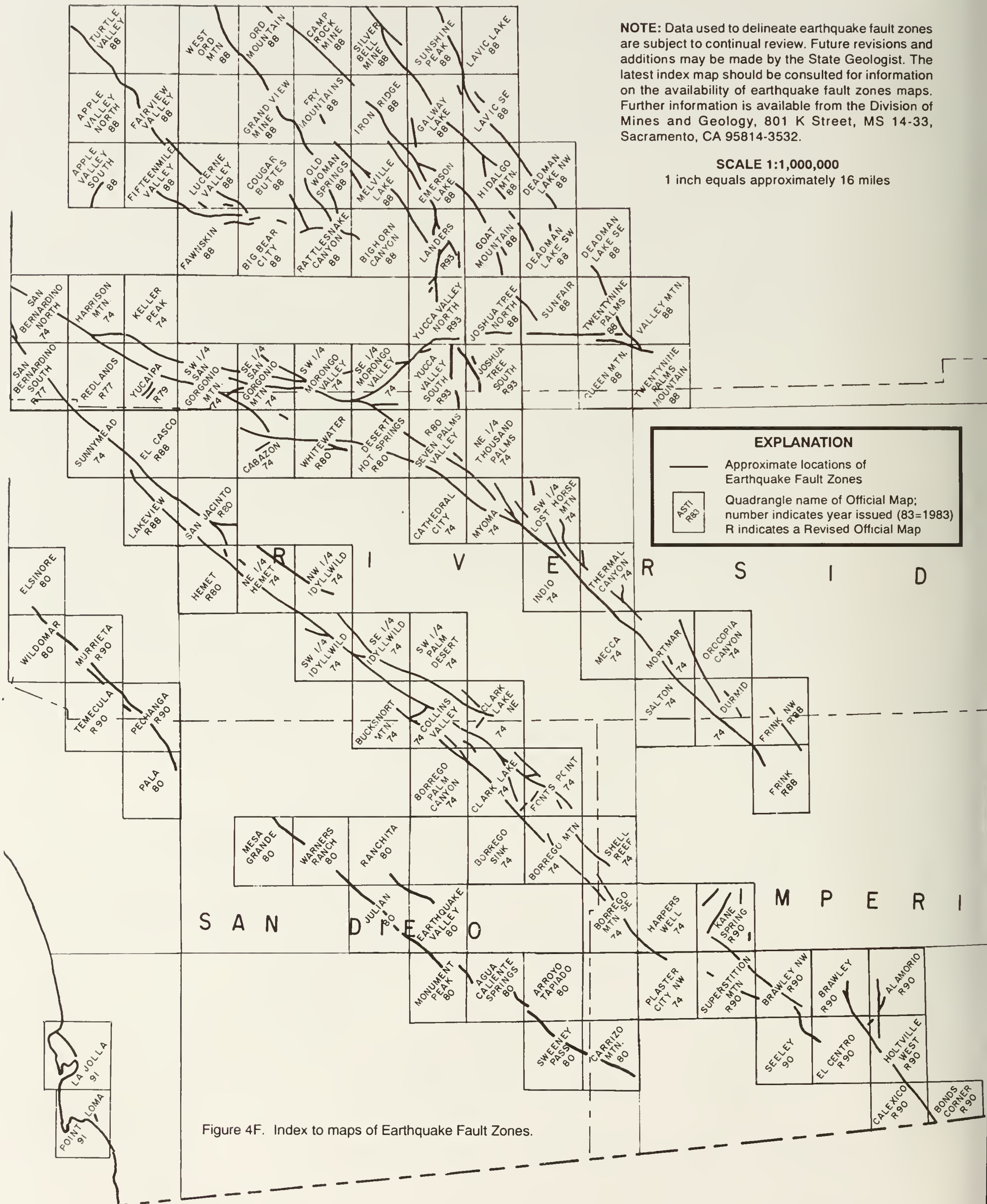


Figure 4F. Index to maps of Earthquake Fault Zones.

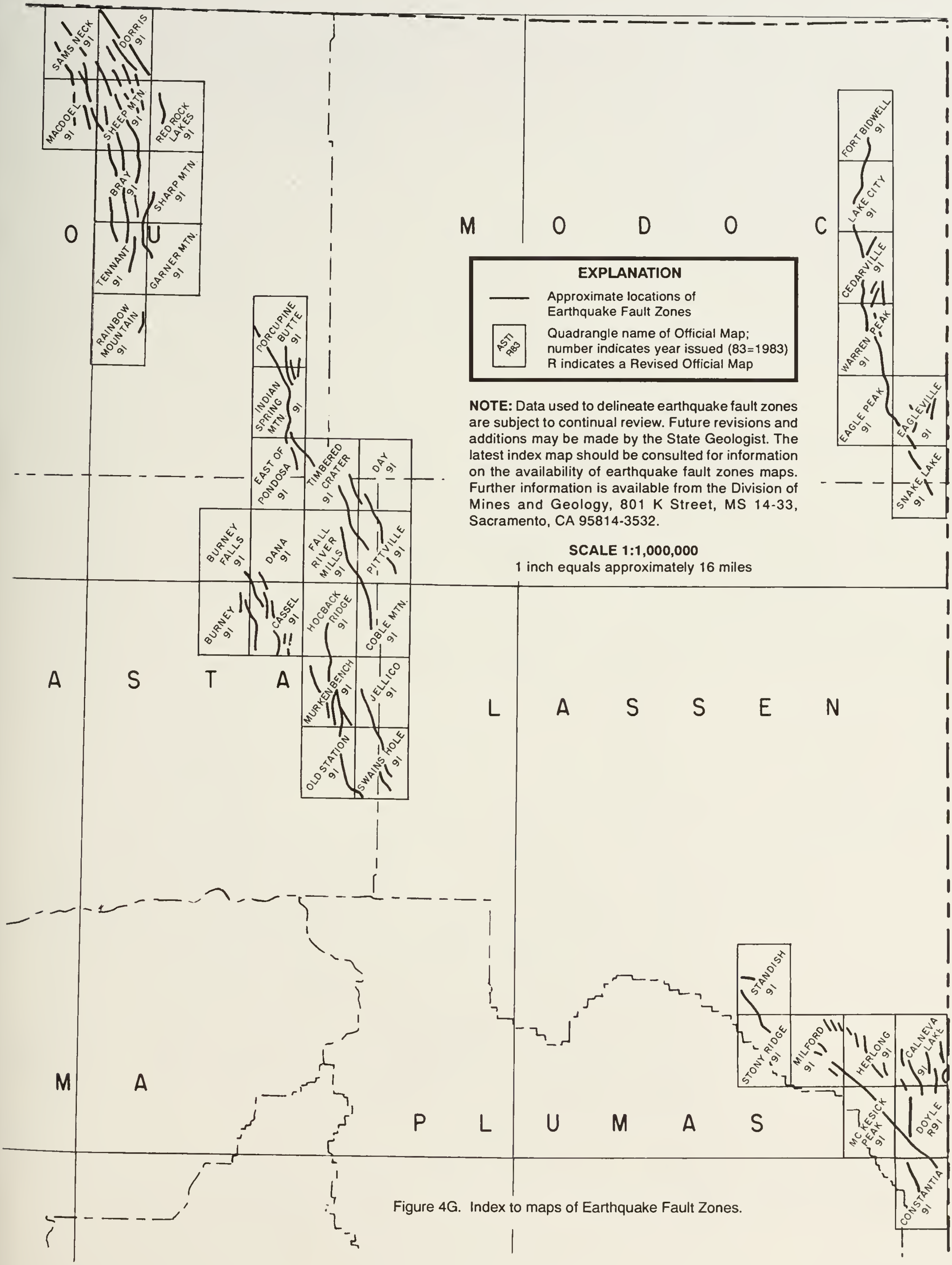
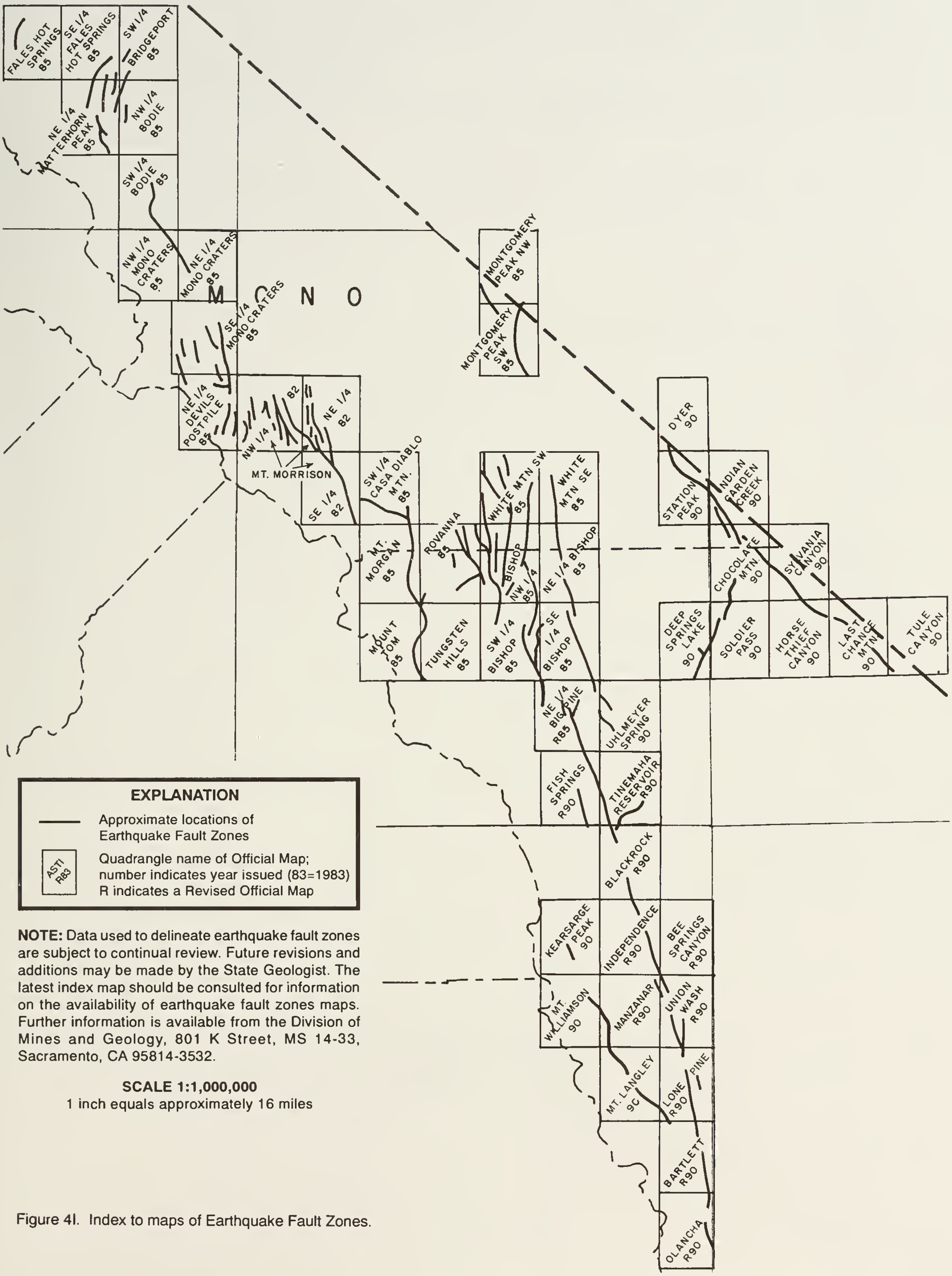


Figure 4G. Index to maps of Earthquake Fault Zones.

NOTE: Data used to delineate earthquake fault zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of earthquake fault zones maps. Further information is available from the Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3532.

SCALE 1:1,000,000
1 inch equals approximately 16 miles

Figure 4H. Index to maps of Earthquake Fault Zones.



EXPLANATION

———	Approximate locations of Earthquake Fault Zones
ASTI R83	Quadrangle name of Official Map; number indicates year issued (83=1983) R indicates a Revised Official Map

NOTE: Data used to delineate earthquake fault zones are subject to continual review. Future revisions and additions may be made by the State Geologist. The latest index map should be consulted for information on the availability of earthquake fault zones maps. Further information is available from the Division of Mines and Geology, 801 K Street, MS 14-33, Sacramento, CA 95814-3532.

SCALE 1:1,000,000
1 inch equals approximately 16 miles

Figure 4I. Index to maps of Earthquake Fault Zones.

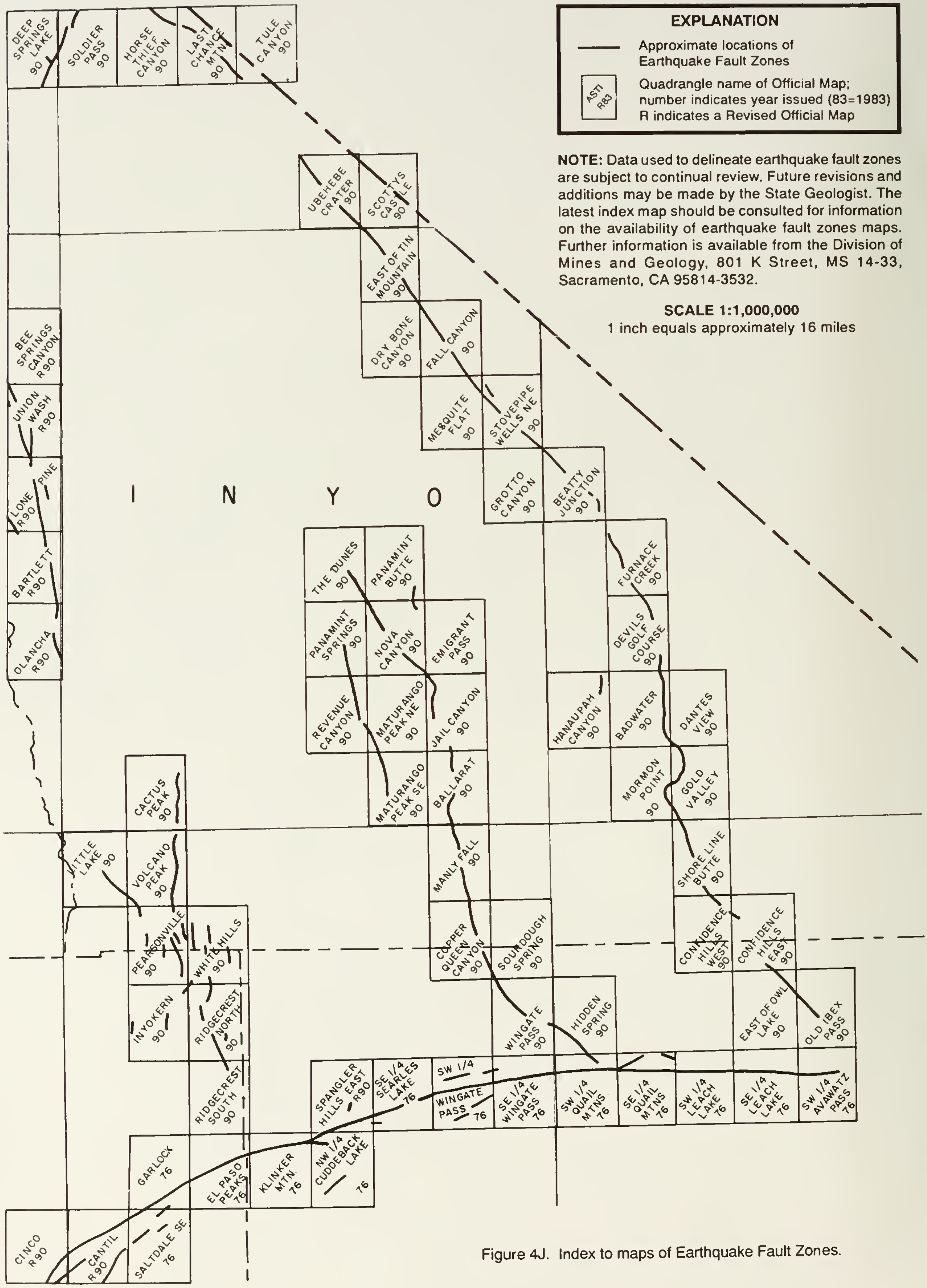


Figure 4J. Index to maps of Earthquake Fault Zones.

APPENDICES

Data are presented herein to provide city and county officials, property owners, developers, geologists, and others with specific information they may need to effectuate the Act.

Because the Act must be implemented at the local government level, it is imperative that the local entities understand its various complex aspects.

Appendix A

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT[1]

Excerpts from California Public Resources Code

DIVISION 2. Geology, Mines and Mining
CHAPTER 7.5 Earthquake Fault Zones[2]

2621. This chapter shall be known and may be cited as the Alquist-Priolo Earthquake Fault Zoning Act.[1]

2621.5. (a) It is the purpose of this chapter to provide for the adoption and administration of zoning laws, ordinances, rules, and regulations by cities and counties in implementation of the general plan that is in effect in any city or county. The Legislature declares that this chapter is intended to provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of active faults. Further, it is the intent of this chapter to provide the citizens of the state with increased safety and to minimize the loss of life during and immediately following earthquakes by facilitating seismic retrofitting to strengthen buildings, including historical buildings, against ground shaking.

(b) This chapter is applicable to any project, as defined in Section 2621.6, which is located within a delineated earthquake fault zone, upon issuance of the official earthquake fault zones maps to affected local jurisdictions, except as provided in Section 2621.7.

(c) The implementation of this chapter shall be pursuant to policies and criteria established and adopted by the Board.[3]

2621.6. (a) As used in this chapter, "project" means either of the following:

(1) Any subdivision of land which is subject to the Subdivision Map Act, (Division 2 (commencing with Section 66410) of Title 7 of the Government Code), and which contemplates the eventual construction of structures for human occupancy.

(2) Structures for human occupancy, with the exception of either of the following:

(A) Single-family wood-frame or steel-frame dwellings to be built on parcels of land for which geologic reports have been approved pursuant to paragraph (1).

(B) A single-family wood-frame or steel-frame dwelling not exceeding two stories when that dwelling is not part of a development of four or more dwellings.

(b) For the purposes of this chapter, a mobilehome whose body width exceeds eight feet shall be considered to be a single-family wood-frame dwelling not exceeding two stories.

2621.7. This chapter, except Section 2621.9, shall not apply to any of the following:

(a) The conversion of an existing apartment complex into a condominium.

(b) Any development or structure in existence prior to May 4, 1975, except for an alteration or addition to a structure that exceeds the value limit specified in subdivision (c).

(c) An alteration or addition to any structure if the value of the alteration or addition does not exceed 50 percent of the value of the structure.

(d) (1) Any structure located within the jurisdiction of the City of Berkeley or the City of Oakland which was damaged by fire between October 20,1991, and October 23, 1991, if granted an exemption pursuant to this subdivision.

(2) The city may apply to the State Geologist for an exemption and the State Geologist shall grant the exemption only if the structure located within the earthquake fault zone is not situated upon a trace of an active fault line, as delineated in an official earthquake fault zone map or in more recent geologic data, as determined by the State Geologist.

(3) When requesting an exemption, the city shall submit to the State Geologist all of the following information:

(A) Maps noting the parcel numbers of proposed building sites that are at least 50 feet from an identified fault and a statement that there is not any more recent information to indicate a geologic hazard.

(B) Identification of any sites within 50 feet of an identified fault.

(C) Proof that the property owner has been notified that the granting of an exemption is not any guarantee that a geologic hazard does not exist.

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[1]Known as the Alquist-Priolo Special Studies Zones Act prior to January 1, 1994.

[2]Known as Special Studies Zones prior to January 1, 1994.

[3]State Mining and Geology Board.

(4) The granting of an exemption does not relieve a seller of real property or an agent for the seller of the obligation to disclose to a prospective purchaser that the property is located within a delineated earthquake fault zone, as required by Section 2621.9.

(e) (1) Alterations which include seismic retrofitting, as defined in Section 8894.2 of the Government Code, to any of the following listed types of buildings in existence prior to May 4, 1975:

(A) Unreinforced masonry buildings, as described in subdivision (a) of Section 8875 of the Government Code.

(B) Concrete tilt-up buildings, as described in Section 8893 of the Government Code.

(C) Reinforced concrete moment resisting frame buildings as described in Applied Technology Council Report 21 (FEMA Report 154).

(2) The exemption granted by paragraph (1) shall not apply unless a city or county acts in accordance with all of the following:

(A) The building permit issued by the city or county for the alterations authorizes no greater human occupancy load, regardless of proposed use, than that authorized for the existing use permitted at the time the city or county grants the exemption. This may be accomplished by the city or county making a human occupancy load determination that is based on, and no greater than, the existing authorized use, and including that determination on the building permit application as well as a statement substantially as follows: "Under subparagraph (A) of paragraph (2) of subdivision (e) of Section 2621.7 of the Public Resources Code, the occupancy load is limited to the occupancy load for the last lawful use authorized or existing prior to the issuance of this building permit, as determined by the city or county."

(B) The city or county requires seismic retrofitting, as defined in Section 8894.2 of the Government Code, which is necessary to strengthen the entire structure and provide increased resistance to ground shaking from earthquakes.

(C) Exemptions granted pursuant to paragraph (1) are reported in writing to the State Geologist within 30 days of the building permit issuance date.

(3) Any structure with human occupancy restrictions under subparagraph (A) of paragraph (2) shall not be granted a new building permit that allows an increase in human occupancy unless a geologic report, prepared pursuant to subdivision (d) of Section 3603 of Title 14 of the California Code of Regulations in effect on January 1, 1994, demonstrates that the structure is not on the trace of an active fault, or the requirement of a geologic report has been waived pursuant to Section 2623.

(4) A qualified historical building within an earthquake fault zone that is exempt pursuant to this subdivision may be repaired or seismically retrofitted using the State Historical Building Code, except that, notwithstanding any provision of that building code and its implementing regulations, paragraph (2) shall apply.

2621.8. Notwithstanding Section 818.2 of the Government Code, a city or county which knowingly issues a permit that grants an exemption pursuant to subdivision (e) of Section 2621.7 that does not adhere to the requirements of paragraph (2) of subdivision (e) of Section 2621.7, may be liable for earthquake-related injuries or deaths caused by failure to so adhere.

2621.9. (a) A person who is acting as an agent for a seller of real property which is located within a delineated earthquake fault zone, or the seller if he is acting without an agent, shall disclose to any prospective purchaser the fact that the property is located within a delineated earthquake fault zone, if the maps prepared pursuant to this chapter, or the information contained in the maps, are reasonably available.

(b) For the purposes of this section, in all transactions that are subject to Section 1102 of the Civil Code, disclosure shall be provided by one of the following means:

(1) The real estate transfer disclosure statement set out in Section 1102.6 of the Civil Code.

(2) The local option real estate transfer disclosure statement set out in subdivision (a) of Section 1102.6 of the Civil Code.

(3) The real estate contract and receipt for deposit.

(c) For the purposes of this section:

(1) "Reasonably available" means that for any county that includes areas covered by a delineated earthquake fault zone map, a notice has been posted at the offices of the county recorder, county assessor, and county planning commission that identifies the location of the map and the effective date of the notice, which shall not exceed 10 days beyond the date the county received the map from the State Geologist.

(2) "Real estate contract and receipt for deposit" means the document containing the offer to sell or purchase real property, that when accepted, becomes a binding contract, and that serves as an acknowledgment of a deposit if one is received.

(d) For purposes of the disclosures required by this section, the following persons shall not be deemed agents of the transferor:

(1) Persons specified in Section 1102.11 of the Civil Code.

(2) Persons acting under a power of sale regulated by Section 2924 of the Civil Code.

(e) For purposes of this section, Section 1102.13 of the Civil Code shall apply.

2622. (a) In order to assist cities and counties in their planning, zoning, and building-regulation functions, the State Geologist shall delineate, by December 31, 1973, appropriately wide earthquake fault zones to encompass all potentially and recently active traces of the San Andreas, Calaveras, Hayward, and San Jacinto Faults, and such other faults, or segments thereof, as the State Geologist determines to be sufficiently active and well-defined as to constitute a potential hazard to structures from surface faulting or fault creep. The earthquake fault zones shall ordinarily be one-quarter mile or less in width, except in circumstances which may require the State Geologist to designate a wider zone.

(b) Pursuant to this section, the State Geologist shall compile maps delineating the earthquake fault zones and shall submit the maps to all affected cities, counties, and state agencies, not later than December 31, 1973, for review and comment. Concerned jurisdictions and agencies shall submit all comments to the State Mining and Geology Board for review and consideration within 90 days. Within 90 days of such review, the State Geologist shall provide copies of the official maps to concerned state agencies and to each city or county having jurisdiction over lands lying within any such zone.

(c) The State Geologist shall continually review new geologic and seismic data and shall revise the earthquake fault zones or delineate additional earthquake fault zones when warranted by new information. The State Geologist shall submit all revised maps and additional maps to all affected cities, counties, and state agencies for their review and comment. Concerned jurisdictions and agencies shall submit all comments to the State Mining and Geology Board for review and consideration within 90 days. Within 90 days of that review, the State Geologist shall provide copies of the revised and additional official maps to concerned state agencies and to each city or county having jurisdiction over lands lying within the earthquake fault zone.

(d) In order to ensure that sellers of real property and their agents are adequately informed, any county that receives an official map pursuant to this section shall post a notice within five days of receipt of the map at the offices of the county recorder, county assessor, and county planning commission, identifying the location of the map and the effective date of the notice.

2623. (a) The approval of a project by a city or county shall be in accordance with policies and criteria established by the State Mining and Geology Board and the findings of the State Geologist. In the development of such policies and criteria, the State Mining and Geology Board shall seek the comment and advice of affected cities, counties, and state agencies. Cities and counties shall require, prior to the approval of a project, a geologic report defining and delineating any hazard of surface fault rupture. If the city or county finds that no undue hazard of that kind exists, the geologic report on the hazard may be waived, with the approval of the State Geologist.

(b) After a report has been approved or a waiver granted, subsequent geologic reports shall not be required, provided that new geologic data warranting further investigations is not recorded.

(c) The preparation of geologic reports that are required pursuant to this section for multiple projects may be undertaken by a geologic hazard abatement district.

2624. Notwithstanding any provision of this chapter, cities and counties may do any of the following:

(1) Establish policies and criteria which are stricter than those established by this chapter.

(2) Impose and collect fees in addition to those required under this chapter.

(3) Determine not to grant exemptions authorized under this chapter.

2625. (a) Each applicant for approval of a project may be charged a reasonable fee by the city or county having jurisdiction over the project.

(b) Such fees shall be set in an amount sufficient to meet, but not to exceed, the costs to the city or county of administering and complying with the provisions of this chapter.

(c) The geologic report required by Section 2623 shall be in sufficient detail to meet the criteria and policies established by the State Mining and Geology Board for individual parcels of land.

2630. In carrying out the provisions of this chapter, the State Geologist and the board shall be advised by the Seismic Safety Commission.

SIGNED INTO LAW DECEMBER 22, 1972; AMENDED SEPTEMBER 16, 1974, MAY 4, 1975, SEPTEMBER 28, 1975
SEPTEMBER 22, 1976, SEPTEMBER 27, 1979, SEPTEMBER 21, 1990, JULY 29, 1991
AUGUST 16, 1992, JULY 25, 1993, AND OCTOBER 7, 1993

Appendix B

POLICIES AND CRITERIA OF THE STATE MINING AND GEOLOGY BOARD

With Reference to the Alquist-Priolo Special Studies Zones Act[1]

(Excerpts from the California Code of Regulations, Title 14, Division 2)

3600. Purpose.

It is the purpose of this subchapter to set forth the policies and criteria of the State Mining and Geology Board, hereinafter referred to as the "Board," governing the exercise of city, county, and state agency responsibilities to prohibit the location of developments and structures for human occupancy across the trace of active faults in accordance with the provisions of Public Resources Code Section 2621 et seq. (Alquist-Priolo Special Studies Zones Act). The policies and criteria set forth herein shall be limited to potential hazards resulting from surface faulting or fault creep within special studies zones delineated on maps officially issued by the State Geologist.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Sections 2621- 2630, Public Resources Code.

3601. Definitions.

The following definitions as used within the Act and herein shall apply:

(a) An "active fault" is a fault that has had surface displacement within Holocene time (about the last 11,000 years), hence constituting a potential hazard to structures that might be located across it.

(b) A "fault trace" is that line formed by the intersection of a fault and the earth's surface, and is the representation of a fault as depicted on a map, including maps of special studies zones.

(c) A "lead agency" is the city or county with the authority to approve projects.

(d) "Special studies zones" are areas delineated by the State Geologist, pursuant to the Alquist–Priolo Special Studies Zones Act (Public Resources Code Section 2621 et seq.) and this subchapter, which encompass the traces of active faults.

(e) A "structure for human occupancy" is any structure used or intended for supporting or sheltering any use or occupancy, which is expected to have a human occupancy rate of more than 2,000 person-hours per year.

(f) "Story" is that portion of a building included between the upper surface of any floor and the upper surface of the floor next above, except that the topmost story shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. For the purpose of the Act and this subchapter, the number of stories in a building is equal to the number of distinct floor levels, provided that any levels that differ from each other by less than two feet shall be considered as one distinct level.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Sections 2621 - 2630, Public Resources Code.

3602. Review of Preliminary Maps.

(a) The Board shall provide an opportunity for receipt of public comments and recommendations during the ninety (90) day period provided by Public Resources Code Section 2622, which shall include at least one public meeting scheduled for that purpose.

(b) Following the end of the 90-day review period, the Board shall forward its comments and recommendations, with supporting data received, to the State Geologist for consideration prior to his officially issuing the maps.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Section 2622, Public Resources Code.

3603. Specific Criteria.

The following specific criteria shall apply within special studies zones and shall be used by affected lead agencies in complying with the provisions of the act:

(a) No structure for human occupancy, identified as a project under Section 2621.6 of the Act, shall be permitted to be placed across the trace of an active fault. Furthermore, as the area within fifty (50) feet of such active faults shall be presumed to be underlain by active branches of that fault unless proven otherwise by an appropriate geologic investigation and report prepared as specified in Section 3603(d) of this subchapter, no such structures shall be permitted in this area.

(b) Affected lead agencies, upon receipt of official special studies zones maps, shall provide for disclosure of delineated special studies zones to the public. Such disclosure may be by reference in general plans, specific plans, property maps, or other appropriate local maps.

(c) No change in use or character of occupancy, which results in the conversion of a building or structure from one not used for human occupancy to one that is so used, shall be permitted unless the building or structure complies with the provisions of the Act.

(d) Application for a development permit for any project within a delineated special studies zone shall be accompanied by a geologic report prepared by a geologist registered in the State of California, which is directed to the problem of potential surface fault displacement through the project site, unless such report is waived pursuant to Section 2623 of the Act. The required report shall be based on a geologic investigation designed to identify the location, recency, and nature of faulting that may have affected the project site in the past and may affect the project site in the future. The report may be combined with other geological or geotechnical reports.

(e) A geologist registered in the State of California, within or retained by each lead agency, shall evaluate the geologic reports required herein and advise the lead agency.

[1] On January 1, 1994, the name of the act was changed to Alquist-Priolo Earthquake Fault Zoning Act and the name of the zones changed to Earthquake Fault Zones. At the time of this printing these name changes had not yet been reflected in the regulations.

(f) One (1) copy of all such geologic reports shall be filed with the State Geologist by the lead agency within thirty (30) days following the report's acceptance. The State Geologist shall place such reports on open file.

NOTE: Authority cited: Section 2621.5, Public Resources Code. Reference: Sections 2621.5, 2622, 2623, and 2625(c), Public Resources Code.

ADOPTED NOVEMBER 23, 1973; REVISED JULY 1, 1974, AND JUNE 26, 1975.
CODIFIED IN CALIFORNIA CODE OF REGULATIONS JANUARY 31, 1979;
REVISED OCTOBER 18, 1984 (EFFECTIVE 30 DAYS THEREAFTER).

Appendix C

GUIDELINES FOR EVALUATING THE HAZARD OF SURFACE FAULT RUPTURE

(These guidelines are not part of the Policies and Criteria of the State Mining and Geology Board. The guidelines are slightly revised and reprinted from DMG Note 49.)

These guidelines are to assist geologists who investigate faults relative to the hazard of primary surface rupture. Subsequent to the passage of the Alquist-Priolo Earthquake Fault Zoning Act (1972), it became apparent that many fault investigations conducted in California were incomplete or otherwise inadequate for the purpose of evaluating the potential of surface fault rupture. It was further apparent that statewide standards for investigating faults would be beneficial.

The investigation of sites for the possible hazard of surface fault rupture is a deceptively difficult geologic task. Many active faults are complex, consisting of multiple breaks. Yet the evidence for identifying active faults traces is generally subtle or obscure and the distinction between recently active and long-inactive faults may be difficult to make. Once a structure is sited astride an active fault, the resulting fault-rupture hazard cannot be mitigated unless the structure is relocated, whereas when a structure is placed on a landslide, the hazard from landsliding often can be mitigated. Further, it is impractical from an economic, engineering, and architectural point of view to design a structure to withstand serious damage under the stress of surface fault rupture. Thus, the evaluation of a site for the hazard of surface fault rupture is a difficult and delicate procedure.

Because of the complexity of evaluating surface and near surface faults and because of the infinite variety of site conditions, no single investigative method will be the best, or even useful, at all sites. Nonetheless, certain investigative methods are more helpful than others in locating faults and evaluating the recency of activity.

The evaluation of a given site with regard to the potential hazard of surface fault rupture is based extensively on the concepts of *recency* and *recurrence* of faulting along existing faults. In a general way, the more recent the faulting the greater the probability for future faulting (Allen, 1975). Stated another way, faults of known historic activity during the last 200 years, as a class, have a greater probability for future activity than faults classified as Holocene age (last 11,000 years) and a much greater probability of future activity than faults classified as Quaternary age (last 1.6 million years). However, it should be kept in mind that certain faults have recurrent activity measured in tens or hundreds of years whereas other faults may be inactive for thousands of years before being reactivated. Other faults may be characterized by creep-type rupture. The magnitude, sense, and nature of fault rupture also vary for different faults or even along different segments of the same fault. Even so, future faulting generally is expected to recur along pre-existing faults (Bonilla, 1970, p. 68). The development of a new fault or reactivation of a long-inactive fault is relatively uncommon and generally need not be a concern in site development.

As a practical matter, fault investigations should be directed at the problem of locating existing faults and then attempting to evaluate the recency of their activity. It is pointed out that data are obtained both from the site and outside the site area. The most direct method of evaluating recency is to observe (in a trench or road cut) the youngest geologic unit faulted and the oldest unit that is not faulted. Recently active faults may also be identified by direct observation of young, fault-related geomorphic (i.e. topographic) features in the field, on aerial photographs, or on remotely obtained images. Other indirect and more interpretive methods are identified in the outline below. Some of these methods are discussed in Slemmons (1977), Bonilla (1982), Wallace (1977), Taylor and Cluff (1973), Sherard and others (1974), Hatheway and Leighton (1979), the National Research Council (1986), the Utah Section of the Association of Engineering Geologists (1987), and Slemmons and dePolo (1992), but no comprehensive manual on the subject of fault investigation and evaluation exists at this time. Many other useful references exist and are listed in the bibliographies of the references cited here.

The following annotated outline provides guidelines for a comprehensive fault investigation that may be applied to any project site, large or small. Fault investigations may be conducted in conjunction with other geological and geotechnical investigations [see DMG Notes 42 and 44]. Although not all investigative techniques need to be or can be employed in evaluating a given site, the outline provides a checklist for preparing complete and well-documented reports. Since most reports on fault investigations are filed with and reviewed by local and state government agencies, it is necessary that the reports be documented adequately and written carefully to facilitate that review. The importance of the review process is emphasized here, because it is the reviewer who must evaluate the adequacy of reports, interpret or set standards where they are unclear, and advise the governing agency as to their acceptability (Hart and Williams, 1978) (see Appendix D).

The scope of the investigation is dependent not only on complexity and economics of a project, but also on the level of risk acceptable for the proposed structure or development (Joint Committee on Seismic Safety, 1974, p.9). Obviously, a more detailed investigation should be made for hospitals, high-rise buildings, and other critical or sensitive structures than for low-occupancy structures such as wood-frame dwellings that are comparatively safe. The conclusions drawn from any given set of data, however, must be consistent and unbiased. Recommendations must be clearly separated from conclusions, since recommendations are not totally dependent on geologic factors. The final decision as to whether, or how, a given project should be developed lies in the hands of the owner and the governing body that must review and approve the project.

Suggested Outline for Geologic Reports on Faults

The following subjects should be addressed, or at least considered, in any geologic report on faults. Some of the investigative methods listed below should be carried out well beyond the site being investigated. However, it is not expected that all of the methods identified would be used in a single investigation.

I. Text.

A. Purpose and scope of investigation.

B. Geologic setting.

C. Site description and conditions. Include information on geologic units, graded and filled areas, vegetation, existing structures, and other factors that may affect the choice of investigative methods and the interpretation of data.

D. Methods of investigation.

1. Review of published and unpublished literature and records concerning geologic units, faults, ground-water barriers, and other factors.
2. Stereoscopic interpretation of aerial photographs and other remotely sensed images to detect fault-related topography, vegetation and soil contrasts, and other lineaments of possible fault origin.
3. Surface observations, including mapping of geologic and soil units, geologic structures, geomorphic features, springs, deformation of manmade structures due to fault creep, both on and beyond the site.
4. Subsurface investigations.
   a. Trenching and other excavations to permit detailed and direct observation of continuously exposed geologic units, soils and structures; must be of adequate depth and be carefully logged (see Taylor and Cluff, 1973).
   b. Borings and test pits to permit collection of data on geologic units and ground water at specific locations. Data points must be sufficient in number and spaced adequately to permit valid correlations and interpretations.
5. Geophysical investigations. These are indirect methods that require a knowledge of specific geologic conditions for reliable interpretations. They should seldom, if ever, be employed alone without knowledge of the geology (Chase and Chapman, 1976). Geophysical methods alone never prove the absence of a fault nor do they identify the recency of activity. The types of equipment and techniques used should be described.
   a. Seismic reflection.
   b. Seismic refraction.
   c. Ground-penetrating radar
   d. Other (e.g., magnetic intensity, electrical resistivity, gravity).
6. Other methods should be included when special conditions permit, or requirements for critical structures demand, a more intensive investigation.
   a. Aerial reconnaissance overflights.
   b. Geodetic and strain measurements, microseismicity monitoring, or other monitoring techniques.
   c. Radiometric analysis (14C, K-Ar), stratigraphic correlation (fossils, mineralogy), soil profile development, paleomagnetism (magnetostratigraphy), or other age-dating techniques to identify the age of faulted or unfaulted units or surfaces.

E. Conclusions.

1. Location and existence (or absence) of hazardous faults on or adjacent to the site.
2. Type of faults and nature of anticipated offset, including sense and magnitude of displacement, if possible.
3. Probability of or relative potential for future surface displacement. The likelihood of future ground rupture seldom can be stated mathematically, but may be stated in semiquantitative terms such as low, moderate, or high, or in terms of slip rates determined for specific fault segments.
4. Degree of confidence in and limitations of data and conclusions.

F. Recommendations.

1. Setback distances from hazardous faults, if appropriate. State and local law may dictate minimum standards (see Appendix B).
2. Need for additional studies.
3. Risk evaluation relative to the proposed development–opinions are acceptable. But remember that the ultimate decision as to whether the risk is acceptable lies with the governing body.

II. References.

A. Literature and records cited or reviewed; citations should be complete.

B. Aerial photographs or images interpreted–list type, date, scale, source, and index numbers.

C. Other sources of information, including well records, personal communications, and other data sources.

III. Illustrations–these are essential to the understanding of the report and to reduce the length of text.

A. Location map–identify site locality, significant faults, geographic features, regional geology, seismic epicenters, and other pertinent data; 1:24,000 scale is recommended.

B. Site development map–show site boundaries, existing and proposed structures, graded areas, streets, exploratory trenches, borings, geophysical traverses, and other data; recommended scale is 1 inch equals 200 feet, or larger.

C. Geologic map–shows distribution of geologic units (if more than one), faults and other structures, geomorphic features, aerial photo lineaments, and springs; on topographic map 1:24,000 scale or larger; can be combined with III (A) or III (B).

D. Geologic cross-sections, if needed to provide 3-dimensional picture.

E. Logs of exloratory trenches, and borings– show details of observed features and conditions; should not be generalized or diagrammatic. Trench logs should show topographic profile and geologic structure at a 1:1 horizontal to vertical scale.

F. Geophysical data and geologic interpretations.

IV. Appendix: Supporting data not included above (e.g., water well data).

V. Authentication: Signature and registration number of investigating geologist.

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Slemmons, D.B., 1977, State-of-the-art for assessing earthquake hazards in the United States: Report 6, faults and earthquake magnitude: U.S. Army Engineer Waterways Experiment Station Miscellaneous Paper S-73-1, 129 p. with 37 p. appendix. (Summarizes fault evaluation techniques; extensive bibliography).

Slemmons, D.B., and dePolo, C.M., 1992, Evaluation of active faulting and associated hazards in Studies in Geophysics–Active Tectonics: National Research Council, p. 45-62.

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Appendix D

GENERAL GUIDELINES FOR REVIEWING GEOLOGIC REPORTS

(Note: These general guidelines are slightly modified from an article titled "Geologic Review Process" by Hart and Williams (1978) and published in California Geology.)

The purpose of this article is to provide general guidance for those geologists who review geologic reports of consultants on behalf of agencies having approval authority over specific developments.

The geologic review is a critical part of the evaluation process of a proposed development. It is the responsibility of the reviewer to assure that each geologic investigation, and the resulting report, adequately addresses the geologic conditions that exist at a given site. In addition to geologic reports for tentative tracts and site development, a reviewer evaluates Environmental Impact Reports, Seismic Safety and Public Safety Elements of General Plans, as-graded geologic reports, and final, as-built geologic maps and reports. In a sense, the geologic reviewer enforces existing laws and regulations to assure that significant geologic factors (hazards, mineral and water resources, geologic processes) are properly considered, and potential problems are mitigated prior to project development. Generally, the reviewer acts on behalf of a governing agency–city, county, regional, state, federal–not only to protect the government's interest but also to protect the interest of the community at large. Examples of the review process in a state agency are described by Stewart and others (1976). Review at the local level has been discussed by Leighton (1975), Berkland (1992), Larson (1992), and others. Grading codes, inspections, and the review process are discussed in detail by Scullin (1983). Nelson and Christenson (1992) specifically discuss review guidelines for reports on surface faulting.

The need to review geologic reports is emphasized by the fact that geologic hazards and factors are extremely difficult and complex to evaluate. No individual can be totally competent to employ all of the techniques and tools available to the geologic profession. An experienced reviewer, familiar with local geologic conditions, often can identify deficiencies of an investigation merely by closely examining a report. It is important to note that most consultants see themselves, to varying degrees, as proponents for their clients (that is, the developers). By providing a different perspective, the reviewer is able to assist the investigator and to protect the interests of the agency and the public.

THE REVIEWER

Qualifications

In order to make appropriate evaluations of geologic reports, the reviewer must be an experienced geologist familiar with the investigative methods employed and the techniques available to the profession. Even so, the reviewer must know his or her limitations, and at times ask for the opinions of others more qualified in specialty fields (for example, geophysics, mineral exploitation and economics, ground water, foundation and seismic engineering, seismology). In California, the reviewer must be licensed by the State Board of Registration for Geologists and Geophysicists in order to practice. The Board also certifies engineering geologists (Wolfe, 1975). Local and regional agencies may have additional requirements.

The reviewer must have the courage of his or her convictions and should not approve reports if an inadequate investigation has been conducted. Like any review process, there is a certain "give-and-take" involved between the reviewer and investigator. If there is clear evidence of incompetence or misrepresentation in a report, this fact should be reported to the reviewing agency or licensing board. Clearly, the reviewer needs to have the support of his or her agency in order to carry out these duties.

The reviewer should bear in mind that some geologic investigators are not accomplished writers, and almost all are working with restricted budgets. Thus, while a reviewer should demand that certain standards be met, he or she should avoid running rough-shod over the investigator. The mark of a good reviewer is the ability to sort out the important from the insignificant and to make constructive comments and recommendations.

A reviewer may be employed full time by the reviewing agency or part-time as a consultant. Also, some reviewing agencies (such as a city) contract with another agency (such as a county) to perform a geologic review on a contract basis. The best reviews generally are performed by experienced reviewers. Thus, the use of multiple, part-time reviewers by a given agency tends to prevent development of high-quality and efficient reviews. One of the reasons for this is that different reviewers have different standards, which results in inconsistent treatment of development projects. The primary purpose of the review procedure should always be kept in mind–namely, to assure the adequacy of geologic investigations.

Other Review Functions

Aside from his or her duties as a reviewer, the reviewing geologist also must interpret the geologic data reported to other agency personnel who regulate development (for example, planners, engineers, inspectors). Also, the reviewing geologist sometimes is called upon to make investigations for his or her own agency. This is common where a city or county employs only one geologist. In fact, some reviewers routinely divide their activities between reviewing the reports of others and performing one or several other tasks for the employing agency (such as advising other agency staff and boards on geologic matters; making public presentations) (see Leighton, 1975).

Conflict of Interest

In cases where a reviewing geologist also must perform geological investigations, he or she should never be placed in the position of reviewing his or her own report, for that is no review at all. A different type of conflict commonly exists in a jurisdiction where the geologic review is performed by a consulting geologist who also is practicing commercially (performing geological investigations) within the same jurisdictional area. Such situations should be avoided, if at all possible.

GEOLOGIC REVIEW

The Report

The critical item in evaluating specific site investigations for adequacy is the resulting geologic report. A report that is incomplete or poorly written cannot be evaluated and should not be approved. As an expediency, some reviewers do accept inadequate or incomplete reports because of their personal knowledge of the site. However, unless good reasons can be provided in writing, it is recommended that a report not be accepted until it presents the pertinent facts correctly and completely.

The conclusions presented in the report regarding the geologic hazards or problems must be separate from and supported by the investigative data. An indication regarding the level of confidence in the conclusions should be provided. Recommendations based on the conclusions should be made to mitigate those geology-related problems which would have an impact on the proposed development. Recommendations also should be made concerning the need for additional geologic investigations.

Report Guidelines and Standards

An investigating geologist may save a great deal of time (and the client's money), and possibly misunderstandings, if he or she contacts the reviewing geologist at the initiation of the investigation. The reviewer should not only be familiar with the local geology and sources of information, he or she also should be able to provide specific guidelines for investigative reports and procedures to be followed. Guidelines and check-lists for geologic or geotechnical reports have been prepared by a number of reviewing agencies and are available to assist the reviewer in his or her evaluation of reports (for example, CDMG Notes 42, 44, 46, 48, and 49). A reviewer also may wish to prepare his or her own guidelines or check-lists for specific types of reviews.

If a reviewer has questions about an investigation, these questions must be communicated in writing to the investigator for response. After the reviewer is satisfied that the investigation and resulting conclusions are adequate, this should be clearly indicated in writing to the reviewing agency so that the proposed development application may be processed promptly.

The biggest problem the reviewer faces is the identification of standards. These questions must be asked: "Are the methods of investigation appropriate for a given site?" and "Was the investigation conducted according to the existing state-of-the-art standards?". Answers to these questions lie in the report being reviewed. For example, a reported landslide should be portrayed on a geologic map of the site. The conclusion that a hazard is absent, where previously reported or suspected, should be documented by stating which investigative steps were taken and precisely what was seen. The reviewer must evaluate each investigative step according to existing standards. Often the reviewer is forced to clarify the standards, or even introduce new ones, for a specific purpose.

Depth (Intensity) of Review

The depth of the review is determined primarily by the need to assure that an investigation and resulting conclusions are adequate, but too often the depth of review is controlled by the time and funds available. A report on a subdivision may be simply evaluated against a check-list to make certain it is complete and well-documented. Additionally, the reviewer may wish to check cited references or other sources of data, such as aerial photos and unpublished records.

Reviewers also may inspect the development site and examine excavations and borehole samples. Ideally, a field visit may not be necessary if the report is complete and well-documented. However, field inspections are of value, and often are necessary, to determine if field data are reported accurately and completely. Also, if the reviewer is not familiar with the general site conditions, a brief field visit provides perspective and a visual check on the reported conditions. Whether or not on-site reviews are made, it is important to note that the geologic review process is not intended to replace routine grading inspections that may be required by the reviewing agency to assure performance according to an approved development plan.

Appeals

In cases where the reviewer is not able to approve a geologic report, or can accept it only on a conditional basis, the developer may wish to appeal the review decision or recommendations. However, every effort should be made to resolve problems informally prior to making a formal appeal. An appeal may be handled through existing legal procedures (such as a hearing by a County Board of Supervisors, or a City Council) or by a specially appointed Review and Appeals Board. Adequate notice should be given to allow time for both sides to prepare their cases. After an appropriate hearing, the appeals decision must be made promptly and in writing as part of the permanent record.

Another way to remedy conflicts between the investigator and the reviewer is by means of a third party review. Such a review can take different paths ranging from the review of existing reports to in-depth field investigations. Third party reviews are usually done by consultants not normally associated with the reviewing/permitting agency.

REFERENCES

DMG Notes of California Division of Mines and Geology:

Note 42 -- Guidelines to geologic/seismic reports

Note 44 -- Guidelines for preparing engineering geologic reports

Note 46 -- Guidelines for geologic/seismic considerations in environmental impact reports

Note 48 -- Checklists for the review of geologic/seismic reports

Note 49 -- Guidelines for evaluating the hazard of surface fault rupture

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Appendix E

PRODUCTS OF THE FAULT EVALUATION AND ZONING PROGRAM

(Modified from California Geology, March 1991)

Since the passage of the AP Act, staff of the Fault Evaluation and Zoning Program have published numerous reports on the Act and the surface fault rupture hazard. These, as well as unpublished files of geologic information, are listed below. A notation next to each entry is the publication number: CG– California Geology, N– DMG Note, SP– Special Publication, SR– Special Report, o.p. – report is out of print, * an outside publication not available from DMG. Numbers alone (e.g., 89-16) are Open File Report numbers. The publications are listed chronologically by groups below.

AVAILABILITY

Reports listed here are available for reference at offices of the Division of Mines and Geology in Sacramento, San Francisco, and Los Angeles. Some reports are also available for reference at county and university libraries. Copies of available DMG reports may be purchased by mail order or over-the-counter from any office (see exceptions below):

OFFICES OF THE DIVISION OF MINES AND GEOLOGY:

GEOLOGIC INFORMATION AND PUBLICATIONS
801 K Street
MS 14-33
Sacramento, CA 95814-3532
(916) 445-5716

BAY AREA REGIONAL OFFICE
185 Berry Street, #3600
San Francisco, CA 94107
(415) 904-7707

SOUTHERN CALIFORNIA REGIONAL OFFICE
107 South Broadway, Room 1065
Los Angeles, CA 90012-4402
(213) 620-3560

IMPLEMENTATION OF THE ALQUIST-PRIOLO ACT

Official Maps of Special Studies Zones, by California Division of Mines and Geology, 1974-1993. As of January 1, 1994, 535 new and revised Official APSSZ maps have been issued. Special Publication 42 provides an index to these maps and describes how they can be purchased.

SP 42 — **Fault-rupture hazard zones in California,** by E.W. Hart, 1994, 34 p. Includes an index map which identifies all 7.5-minute topographic maps in which AP Earthquake Fault Zones are located.(Revised periodically.)

CG — **Zoning for surface fault hazards in California–The New Special Studies Zones maps,** by E.W. Hart, 1974: v. 27, n. 10, p. 227-230.

N 49 — **Geologic guidelines for evaluating the hazard of surface fault rupture,** by E.W. Hart, 1975 (also Appendix C in SP 42.)

SP 47 o.p. — **Active fault mapping and evaluation program–10-year program to implement Alquist-Priolo Special Studies Zones Act, 1976.**

CG — **The review process and the adequacy of geologic reports,** by R.M. Stewart, E.W. Hart, and P.Y. Amimoto, 1976: Bulletin of the International Association of Engineering Geology, no.14, p. 83-88. (Reprinted in California Geology, v. 30, n. 10, p. 224-229).

CG — **Geologic review process,** by E.W. Hart and J.W. Williams, 1978: v. 31, n. 10, p. 235-236.

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CG — **Fault Evaluation and Zoning Program,** by E.W. Hart, 1980: v. 33, n. 7, p. 147-152.

* **Zoning for surface-faulting in California,** by E.W. Hart, 1986, in **Proceedings of Conference XXXII–Workshop on Future directions in evaluating earthquake hazards in southern California,** Nov. 12-13, 1985: U.S. Geological Survey Open-File Report 86-401, p. 74-83.

90-18 **A study of the effectiveness of the Alquist-Priolo Program,** by R. Reitherman and D.J. Leeds, 1990.

POST-EARTHQUAKE INVESTIGATIONS

CG **Ground rupture associated with faulting - Oroville earthquake, August 1975,** by E.W. Hart, 1975: v. 28, p. 274-276.

SR 124 **Ground rupture along the Cleveland Hill fault,** by E.W. Hart and J.S. Rapp, 1975, in R.W. Sherburne and C.J. Hauge, editors, **Oroville, California, Earthquake 1 August 1975,** p. 61-72.

* **Geologic setting, historical seismicity and surface effects of the Imperial Valley earthquake, October 15, 1979, Imperial County, California,** by E. Leivas, E.W. Hart, R.D. McJunkin, and C.R. Real, 1980, in **Imperial County, California, Earthquake, October 15, 1979** : EERI Reconnaissance Report, February 1980, p. 5-19.

81-5 **Preliminary map of October 1979 fault rupture, Imperial and Brawley faults, Imperial County, California,** by E.W. Hart, 1981.

80-12 o.p. **Preliminary map of surface rupture associated with the Mammoth Lakes earthquakes, May 25 and 27, 1980,** by W.A. Bryant, G.C. Taylor, E.W. Hart, and J.E. Kahle, 1980.

SR 150 **Surface rupture associated with the Mammoth Lakes earthquakes of 25 and 27 May, 1980,** by G.C. Taylor and W.A. Bryant, 1980, in R.W. Sherburne, editor, **Mammoth Lakes, California earthquakes of May 1980,** p. 49-67.

SR 150 **Rockfalls generated by the Mammoth Lakes earthquakes of May 25 and 27, 1980,** by W.A. Bryant, 1980, in R.W. Sherburne, editor, **Mammoth Lakes, California earthquakes of May 1980,** p. 69-73.

SR 150 **Planned zoning of active faults associated with the Mammoth Lakes earthquakes of May 1980,** by E.W. Hart, 1980, in R.W. Sherburne, editor, **Mammoth Lakes, California earthquakes of May 1980,** p. 137-141.

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90-12 **Microfiche copies of Fault Evaluation Reports for the Transverse Ranges,** by Division of Mines and Geology Staff.

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A-P File, reports by consulting geologists, 1974-1993: reports for sites within Special Studies Zones submitted to the Division of Mines and Geology in compliance with the APSSZ Act. Over 2700 reports on file.

C File, reports by consulting geologists that predate the Special Studies Zones, are outside the Zones, or are for developments that are exempt under the APSSZ act. About 800 reports on file.

77-6 o.p. **Index to geologic reports for sites within Special Studies Zones,** by W.Y.C. Lo and J.G. Moreno, 1977 (superseded by OFR 84-31).

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Appendix F

WAIVER PROCEDURE FOR THE ALQUIST-PRIOLO ACT

Section 2623 of the Act states " If the city or county [having jurisdiction over the lands] finds that no undue [fault] hazard...exists, the geologic report on such hazard may be waived, with approval of the State Geologist". The location of the proposed development or structure may be approved following such waiver.

The State Geologist will review waiver requests only after receiving the Waiver Form completed by the city or county geologist and the property owner, and accompanied by supporting statements and data in writing that would justify approval of the waiver request.

WAIVER FORM FOR THE ALQUIST-PRIOLO ACT

(Pursuant to Chapter 7.5, Div. 2, California Public Resources Code)

1. City or County Geologist, State Registered

I, ______________________________, Registered Geologist,
(Print Name)

representing ______________________________, recommend that the
(City/County

property: ______________________________
(Description, size, proposed development)

____
(Location of Site —also show location on "Earthquake Fault Zones" maps)

______________________________, be granted a waiver from geologic studies
(Permit Number)

relating to active faults. Supporting statements that no undue hazard relative to faults exists at the site are attached to this form in writing on City or County letterhead with the City or County Geologist's signature and registration number, and that the Geologist representing the City or County is in agreement with the data:

Attached Data Includes:	YES	NO		YES	NO
1. Geologic Fault Map(s)	____	____	4. Aerial Photo(s)	____	____
2. Geologic Report(s)	____	____	5. Reference to Report(s)	____	____
3. Subsurface Geologic Data	____	____	6. Other Information	____	____

____
City or County Registered Geologist's Signature R.G. No. Date

2. Owner of the Property

I, ______________________________, acknowledge that the property is within an Earthquake Fault Zone associated with the ______________________________ fault.

____
Owner's Signature Date

3. State Geologist

Date Received by DMG ______________________________
(Date)

Reviewer ______________________________
Registered Geologist's Signature R.G. No. Date

Recommendation of Waiver:

Approved: ☐ Not Approved: ☐ (Explanation attached)

State Approval of Review: ______________________________
State Geologist Date

*Defined in Policies and Criteria of the State Mining and Geology Board (See Appendix B)

Mail form to: **State Geologist**
Division of Mines and Geology
801 K Street, MS 12-30
Sacramento, California 95814-3531

DMG Form/Alquist-Priolo

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